FP 527 N84 1828

HADLEY'S QUADRANT.

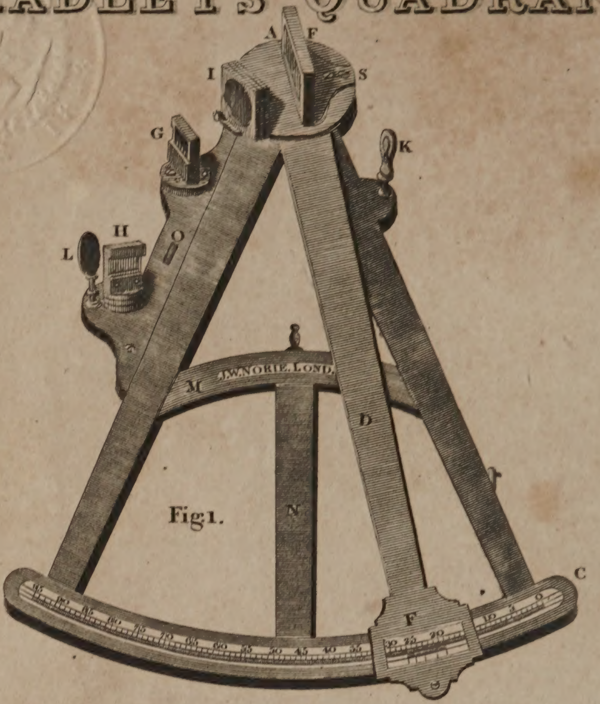

Fig 1.

AZIMUTH COMPASS.

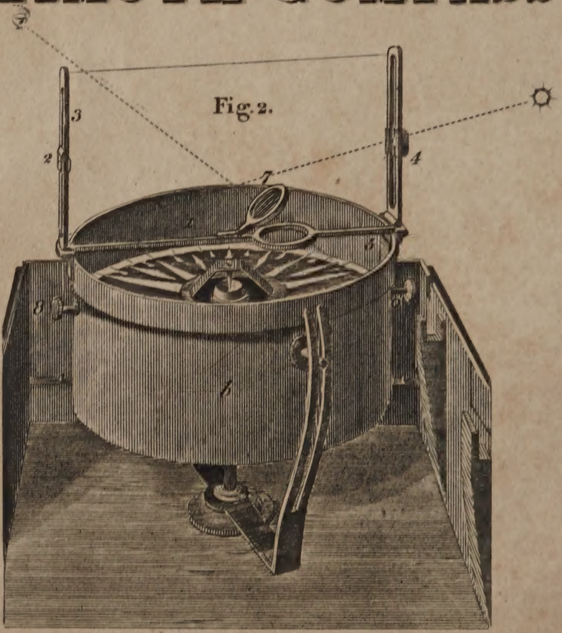

Fig. 2.

J. Norie delin!

Stephenson sc.

A NEW AND
COMPLETE EPITOME
OF
Practical Navigation,
CONTAINING
ALL NECESSARY INSTRUCTION FOR KEEPING A SHIP'S RECKONING
AT SEA.
WITH THE MOST APPROVED METHODS OF ASCERTAINING
THE LATITUDE,
BY MERIDIAN, SINGLE, OR DOUBLE ALTITUDES
AND
THE LONGITUDE,
BY LUNAR OBSERVATIONS, OR TIME-KEEPERS;
INCLUDING
A JOURNAL OF A VOYAGE FROM LONDON TO MADEIRA,
AND EVERY OTHER PARTICULAR REQUISITE TO FORM
THE COMPLETE NAVIGATOR;
THE WHOLE BEING RENDERED PERFECTLY EASY, AND ILLUSTRATED BY
SEVERAL ENGRAVINGS.

TO WHICH IS ADDED,
A NEW AND CORRECT
SET OF TABLES,
More extensive than any hitherto published in a Work of the same Kind, and preceded
by a copious Explanation of each Table.

BY J. W. NORIE,
TEACHER OF NAVIGATION AND NAUTICAL ASTRONOMY.

NINTH (STEREOTYPE) EDITION,
Considerably augmented and improved.

London:
PRINTED FOR THE AUTHOR, AND SOLD BY J. W. NORIE AND CO.
(Successors to the late WILLIAM HEATHER),
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1828.

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PREFACE.

HAVING been for several years past engaged in the instruction of persons designed for, or belonging to the Sea, I have frequently had occasion to lament that most of the existing works on Practical Navigation, and particularly some that have been very generally circulated, are extremely erroneous, both in the instructive and tabular parts, and by no means calculated to answer all the purposes of the Mariner, Teacher, or Pupil.

With a view to remedy these defects, and to facilitate the acquirement of this most important art, and further stimulated by the flattering reception of my former labours, I have ventured to exert my best abilities in composing the present work; and although I do not mean to arrogate to myself any superior professional merit, yet I humbly apprehend, that my long experience and intimate connection with the subject, have enabled me, in some measure, to form a competent judgment of what is most requisite to assist the industrious Mariner in acquiring a knowledge of the practical part of Navigation.

In order to accomplish my intended purpose as effectually as possible, I have examined, with the greatest attention and caution, the various publications that have been written on Navigation, and placing them in a comparative point of view, have, I trust, been thence enabled to avoid the errors, and to improve the merits, of those who have preceded me in this branch of Science.

That nothing might be wanting to assist the student in his progress through the subject, I have commenced with a short treatise on Decimal Arithmetic, the nature of which he will find very necessary to be understood in going through the various computations that follow. In Geometry such definitions and problems only are introduced as appear most essential. Plane Trigonometry, both right and oblique-angled, being the foundation of the Sailings, is treated of at considerable length. Next follows Geography, containing a description of the form and magnitude of the Earth, with its various real and imaginary divisions, and an explanation of the nature of latitude and longitude: an account is then given of the Instruments used for measuring a Ship's way, with the manner of correcting their errors. This finishes the introductory part to Navigation.

We now proceed to the various Sailings in which the examples are resolved by construction, calculation, inspection, and Gunter's Scales; then follows a description of Charts, with the methods of using and constructing them. The Art of Surveying Coasts and Harbours, being very essential to those who visit unknown parts, is treated in a manner which it is hoped will make its acquisition and practice perfectly easy.

We come next to the application of Astronomy to Navigation; and here I have thought proper to give a short but comprehensive view of the solar system, where the Earth is considered as a planet;

and have then described the various imaginary circles of the sphere. The nature of parallax, refraction, &c. are explained under this head. The Theory of the Winds and Tides, with the Methods of finding the Time of High Water, follow next in order.

The most approved Methods of ascertaining the Latitude and Longitude at Sea by Celestial Observations, also the Variation of the Compass by Amplitudes and Azimuths, are explained by proper rules and examples; there is also given a particular description, with the uses of the various astronomical Instruments employed in taking the observations. In this part of the work I have given Mr. Douwes' Rules for computing the Latitude by two Altitudes of the Sun, and four different methods of clearing the Distance, the last of which, invented by Captain Mendoza Rios, has the advantage of not requiring any distinction of cases. The method of finding the Longitude by a Time-keeper being now much practiced, the necessary rules and examples are introduced for that purpose.

The learner is next led into the Rules for keeping a Journal at Sea, wherein are exhibited the Methods of correcting the Courses for Leeway, Variation, &c. with general Rules for working a Day's Work; and the whole is illustrated by separate days' works, and further, by a Journal kept from England to Madeira.

The Explanation of Sea Terms and Technical Phrases, also the substance of an Examination of a Young Sea Officer in the working and of piloting a Ship, I have inserted because, although they may be considered by some as superfluous, and not immediately connected with the subject, they nevertheless appeared to be of too much importance to others to be omitted.

With respect to the Tables in this Work, I have only to observe here, that they are published under the title of "*Nautical Tables*[*]," have been very generally adopted by the Officers in the Navy and in the Honourable East India Company's Service, and have received the approbation of Navigators in general.

Eight Editions of this Treatise having been submitted to the candid judgment of a discerning public, and met with a most flattering reception, I have been induced, both from a sense of gratitude, and an earnest desire of rendering the Work still more useful, to revise the whole with the greatest care and circumspection: in doing this I have made considerable additions, particularly on the subject of determining the Longitude by celestial observations. In the Rules for correcting the apparent distance for the effect of parallax and refraction, I have introduced a fifth method, which, with the assistance of a set of Linear Tables, invented and published by me, is rendered one of the easiest and shortest that have been proposed. I have also treated at considerable length on the use and management of Chronometers, with the method of examining and comparing their rates; have added several new Tables, and corrected the Latitudes and Longitudes of places according to the most modern and best authenticated observations: In short, having made every alteration and improvement that long experience and unremitted attention have suggested, I trust that the present Edition will merit a continuance of that approbation which the work has always hitherto experienced from a liberal and enlightened public.

J. W. NORIE.

Naval Academy, Leadenhall Street.

These Tables are dedicated, by permission, to the Honourable the Court of Directors of the East India Company

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DIRECTION TO THE BINDER.

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NAVIGATION.

INTRODUCTION.

NAVIGATION is that art which instructs the Mariner in what manner to conduct a Ship through the wide and trackless ocean, from one part to another, with the greatest safety, and in the shortest time possible.

It is difficult to trace the origin of this most important Art, to which a diversity of events might have given rise; but, in all probability, it owes its birth to Necessity, the parent of almost every human invention. The Sea Coasts, in many places, are full of Islands at no great distance from the Continent: curiosity would naturally inspire men with an inclination to visit these Islands, and consequently prompt them to devise means by which they might convey themselves from one place to another on the surface of the water; and as this passage did not appear either very long or very dangerous, they determined to attempt it: success in one of these efforts might encourage a second; and we are informed by Pliny, that anciently they sailed only among the Islands, and passed over on rafts or logs of wood.

As Science and Commerce advanced, the machines first used would of course give way to others of more improved structure and greater convenience; and hence the invention of Boats and Vessels of various denominations, better adapted to the nature and extent of the voyages undertaken. In process of time Men being convinced by experience that Vessels designed for navigating the Seas ought to be of a different construction from those intended for Rivers, they would make it their study to give such a form and solidity to Ships designed for the Sea, as would enable them to resist the impetuosity of its waves.

The action of the wind, of which the effects are so sensible and so frequent, might soon suggest the use of sails; but the manner of adjusting and managing them was more difficult, and would not be so soon discovered: this, in fact, appears to have been the last part of the general construction of Vessels that was found out; and this opinion seems confirmed by the practice of Savages in the South Seas and other parts, who generally use only oars or paddles, but seldom have sails: such must have been the case in the first ages.

The confusion and uncertainty in which the first Navigators must have found themselves, when either prompted by their enterprising spirit to visit remote parts, or driven by the violence of storms out of the sight of land, would naturally induce them to study some method of finding where they were in such circumstances: they might soon be sensible that the inspection of the heavenly bodies was the only means that could afford them just conclusions in this respect; in this manner, probably, Astronomy came to be applied to Navigation.

However, leaving these speculations respecting the rise and progress of Navigation, history informs us that the Phœnicians were the first who attained any great proficiency in the Art, especially those of Tyre, their capital, who sent out various colonies, the principal of which settled on the coast of Africa, and built Carthage, a city that in time rivalled Tyre itself. After the destruction of Tyre by Alexander the Great, the Art was transferred by the conqueror to Alexandria, a new city in Egypt, intended by him for the capital of the world; thence diffusing itself, in process of time, throughout the whole of the Mediterranean and parts adjacent.

But Navigation at that time consisted of little more than the management of small barks, which crept along the shore, seldom losing sight of the land: it was not till the discovery of the Compass that Mariners ventured to explore the vast ocean, and sought, as it were, for other worlds, at an immense distance: since that period, the Art has been continually receiving fresh improvements from the efforts of learned and ingenious men, both in respect to the construction of Vessels, and the methods of working and conducting them; so that, at the present time, a voyage to the remotest part of the globe may be performed in the short space of a few months.

Navigation may be divided into two branches: viz. *Seamanship*, comprehending the method of managing a Vessel by disposing her Sails, Rudder, &c. so that she may move in any assigned course or direction the wind or weather will permit; and *Navigation Proper*, (the part we intend principally to treat of in the present work) which comprehends those methods by which a Mariner determines at any time the situation of his Vessel, the course she is to be steered, and the distance she has to run, to gain her intended port: hence the requisites for a Mariner, in order to understand this branch of the Nautical Art, are, a competent knowledge of the figure and magnitude of the earth, with the various imaginary circles drawn upon it, so as to be able to ascertain the distance and situation of places with respect to each other; the method of finding the Ship's Latitude and Longitude, either by her Course and Distance run, or by Astronomical Observations; the use of various Instruments, as the Log, Compass, Half-Minute Glass, Quadrant, Sextant, &c.; the different allowances necessary to be made in estimating a Ship's way, as for Leeway, Variation, and Currents; the Method of finding the time of High Water at any place; the use of Charts, both Plane and Mercator's, with the method of constructing them; all of which particulars, depending upon Mathematical and Astronomical Principles, with whatever relates to the Practical Navigator, we shall endeavour, in the following sheets, to explain and illustrate in such a manner as to render every part as clear, concise, and methodical, as an Art, embracing such a variety of subjects, will possibly admit.

DECIMAL ARITHMETIC.

WHEN any quantity is considered as constituting a whole, it is called an *Integer*; and when an integer is supposed to be divided into a certain number of equal parts, any number of these parts, considered in their relation to the whole, is called a *Fraction*, which is expressed by two numbers placed one above another with a line between them; the lower of these, called the *Denominator*, denotes the number of parts into which the integer or whole is divided, and the upper, called the *Numerator*, expresses how many of these parts is contained in the fraction; for instance, suppose a foot divided into 6 equal parts, and 4 of those parts were to be considered as a fraction of the whole; it would be written in numbers thus $\frac{4}{6}$, where the figure under the line shews that the foot is divided into 6 parts, and the 4 above the line denotes the number of those parts contained in the fraction.

Fractions whose denominators are 10, 100, 1000, &c. that is, a unit with cyphers annexed to it, are called *Decimal Fractions;* but with any other denominators they are called *Vulgar Fractions.*

As the denominators of decimal fractions are always one of the numbers 10, 100, 1000, &c., it is most convenient to write down the numerators only, placing before them a mark called a *decimal point*, to distinguish them from whole numbers; for the value of each place of figures will be known in decimals, as well as in whole numbers, by their distance from the decimal point; which will appear by the following table, where the figures to the left hand of the decimal point are considered as whole numbers, and those to the right, decimals.

Whole Numbers.								Decimals.					
5	6	4	5	6	8	7	.	2	4	6	8	9	3
Millions.	Hund. of Thousands.	Tens of Thousands.	Thousands.	Hundreds.	Tens.	Units.		Tenths	Hundredths.	Thousandths.	Ten Thousandths.	Hund. Thousandths.	Millionths.

Thus . 2 or $\frac{2}{10}$ is read two-tenths, and 87.24, eighty-seven and twenty-four hundredths; the latter of these is called a *mixed number* because it consists of a fraction and an integral or whole number.

In setting down a decimal fraction without its denominator, the numerator must consist of as many places as there are cyphers in the denominator, and if it have not so many figures, the defect must be supplied by setting cyphers before them; thus, $\frac{3}{10}$ is . 3, and $\frac{16}{100}$ is . 16, and $\frac{14}{1000}$ is . 014, and $\frac{5}{1000}$ is . 005, &c

Hence it appears, that as cyphers on the right hand of whole numbers *increase* their value decimally, or in a ten-fold proportion, as 5, 50, 500, &c., so when set on the left of decimal fractions, they *decrease* the value decimally, or in a ten-fold proportion, as . 5, 05, . 005, &c. But cyphers set on the other sides of these numbers make no alteration in their value, either of increase or decrease; so 5, or 05, or 005, &c. are all of the same value, as are . 5, or . 50, or . 500, &c.; for in the latter case it is evident that the numerator increases in the same proportion as the denominator.

Having thus briefly explained the nature of Fractions, we shall now proceed to lay down the rules necessary to be understood in the practice of Navigation, giving a few examples to each by way of illustration.

ADDITION AND SUBTRACTION.

Rule. These are performed exactly the same as in whole numbers, observing always to place the decimal points in a line, so that figures of the same denomination may range under each other.

EXAMPLES IN ADDITION.

.5	53 .2	65 .	720 .1464
.75	79 .46	246 .3	39 .
.253	2 .304	19 .24	7 .246
.582	127 .4	121 .46	259 .1703
2.085	262 .364	452 .00	1025 .5627

EXAMPLES IN SUBTRACTION.

.75	246 .25	174 .	176 .014
.5	19 .5	2 .561	29 .008
.25	226 .75	171 .439	147 .006

MULTIPLICATION

Rule. Multiply the given numbers together as if they were whole numbers, and point off as many decimals in the product counting from the right hand, as there are decimals in the multiplicand and multiplier together. When it happens that there are not so many figures in the product as there must be decimals, supply the defect by prefixing cyphers on the left hand.

EXAMPLES.

25 Multiplicand.	3.275	.2376
.42 Multiplier.	29.5	.0062
50	16375	4752
100	29475	14256
	6550	
1050 Product.		.00147312
	96.6125	

DIVISION.

Rule. Divide as in whole numbers, observing that the divisor and quotient are to contain together as many decimal figures as there are in the dividend; if therefore the dividend have just as many places of decimals as the divisor, the quotient will be a whole number without any decimal figures; if there be more places of decimals in the dividend than in the divisor, point off as many figures in the quotient as there are decimals in the dividend more than in the divisor, a want of places in the quotient being supplied with cyphers on the left hand; and if there be more places of decimals in the divisor than in the dividend, add cyphers to the dividend to make as many places of decimals as in the divisor, then the quotient will be a whole number without decimals.

When after the division there is a remainder, cyphers may be added to the dividend, and the operation continued as before, until either there is no remainder, or a sufficient degree of exactness is obtained in the quotient.

EXAMPLES.

divisor	dividend	quotient	divisor	dividend	quotient
6.5)	7234.5	(1113.	12.5)	.45695	(.0365
	65			375	
	73			819	
	65			750	
	84			695	
	65			625	
	195			70	
	195				

divisor dividend quotient
.423) 476.520 (1126
423
535
423
1122
846
2760
2538
222

divisor dividend quotient
96) 2.30000 (.02395
1 92
380
288
920
864
560
480
80, &c.

REDUCTION.

To reduce a vulgar Fraction to a decimal of the same value.

Rule. Add cyphers at pleasure to the numerator, and divide by the denominator; the quotient will be the decimal fraction required.

EXAMPLES.

Reduce $\frac{3}{6}$ of a Mile to a decimal Fraction.
6) 3.0
.5 or $\frac{5}{10}$, which is a decimal of the same value with the proposed vulgar Fraction $\frac{3}{6}$.

Reduce $\frac{23}{60}$ of a Degree to a decimal Fraction.
60) 23.000 (.383 or $\frac{383}{1000}$ nearly.
180
500
480
200
180
20, &c.

Every quantity may be considered as a fraction of a larger of the same kind; as a league, the $\frac{1}{20}$ of a degree: an inch, the $\frac{1}{12}$ of a foot, &c.; and therefore may be reduced to a decimal fraction, as in the following

EXAMPLES.

What decimal part of a Foot is 9 Inches?
12) 9.00
.75 or $\frac{75}{100}$, which is equal to $\frac{9}{12}$ of a Foot

What is the decimal value of 15 Miles, considered as a Fraction of a Degree?
60) 15.00 (.25 or $\frac{25}{100}$.
120
300
300

When the given quantity consists of several denominations, reduce them to the lowest, as in common arithmetic; likewise reduce the integer to the same denomination; then proceed as before.

EXAMPLES.

Reduce 1 Foot 6 Inches to the decimal of a Yard.

F.	In.	F.
1	6	3 = 1 Yard
12		12
18 Numerat.		36 Denomin.

36) 18 .0 (.5 Answer.
180

Reduce 21 Minutes 54 Seconds to the decimal of a Degree.

	Min.	Sec.	Sec.
	21	54 =	1314 Numerator.
1 Deg. or	60	0 =	3600 Denomina.

3600) 1314.000 (.365 Answer.
10800
23400
21600
18000
18000

To find the Value of a Decimal Fraction in Money, Weight, Measure, &c.

Rule. Multiply the decimal by the number of parts of the next inferior denomination contained in the integer; pointing off in the product as many places for decimals, to the right hand, as the given decimal consists of, and those to the left hand will be an integer number: then multiply the remaining decimals by the number of parts contained in the next inferior denomination, and point off the decimals as before. Proceed thus till it is brought to the lowest denomination.

EXAMPLES.

What is the value of .875 of a pound Sterling?

.875
20
Shillings 17 .500
12
Pence 6 .000

Ansr. 17s. 6d.

12/6
175
875

What is the value of .42 of a Degree*?

.42
60
Min. 25 .20
60
Seconds 12 .00

Ansr. 25 Minutes 12 Seconds

---

* When tenths of a degree or minute are to be reduced into minutes or seconds, it may be expeditiously done by multiplying the tenths by 6, and the product will give the minutes or seconds required; for example, .5 of a degree multiplied by 6 gives 30 minutes and .9 of a minute, 54 seconds. On the contrary to reduce minutes and seconds to tenths of a degree or minute, divide them by 6.

What is the value of .16669 of a Yard?

.16669
3

Feet .50007
12

Inches 6.00084

Ansr. 6 Inches nearly.

What is the value of .259 of a League?

.259
3

Miles .777
8

Furlongs 6.216
220

Yards 47.520

Ansr. 6 Furlongs 47.52 Yards.

RULE OF THREE.

When three numbers are given to find a fourth proportional, the method by which it is performed is called the *Rule of Three*, and is the same in decimals as in common arithmetic: viz. by multiplying the second and third terms together, and dividing the product by the first, when the quotient will give the fourth term or proportional number required, of the same kind with the second. If the given numbers consist of several denominations, they are to be reduced to decimals by the preceding rules.

EXAMPLES

If a Ship sail 49.5 Miles in 8 Hours, how many Miles will she run in 24 Hours supposing her to go at the same Rate?

Hours Miles Hours
8 : 49.5 : : 24
24

1980
990

8) 1188.0

Miles 148.5 Ansr.

Suppose a Watch or Time-piece gains 14 seconds in 5 Days 6 Hours, how much will it gain in 17 Days 15 Hours?

6 Hours = .25 of a day
15 Hours = .625 of a day

days seconds days
5.25 : 14 : : 17.625
17.625

70500
17625

seconds
5.25) 246.750 (47 Ansr.
2100

3675
3675

LOGARITHMICAL ARITHMETIC.

LOGARITHMS[*] are a series of artificial numbers, originally invented by Lord Napier, Baron of Marchiston in Scotland, and afterwards improved by Mr. Briggs, in order to expedite long calculations in Arithmetic; for by using these numbers, the tedious operations of Multiplication and Division are avoided, and performed by Addition and Substraction. This method of calculation is called *Logarithmical Arithmetic.*

MULTIPLICATION.

RULE. Add together the logarithms of the two numbers to be multiplied (found in Table XXIV.) and their sum will be a Logarithm, the natural number corresponding to which will be the product required: if either the multiplicand or multiplier, or both of them, should consist wholly of decimals, and the index of the sum exceed 10, reject the 10 and the remainder will be the index of the Logarithm answering to the product.

EXAMPLES

Multiply	25	Log. 1.39794	Multiply	23.2	Log. 1.365488
by	3	Log. 0.47712	by	6	Log. 9.778151
Product	75	Log. 1.87506	Product	13.92	Log. 1.143639
Multiply	3.71	Log. 0.56937	Multiply	.246	Log. 9.390935
by	2.5	Log. 0.39794	by	.07	Log. 8.845098
Product	9.275	Log. 0.96731	Product	.01722	Log. 8.236033

DIVISION.

RULE. From the logarithm of the dividend subtract the logarithm of the divisor, and the remainder will be a logarithm, whose corresponding number will be the quotient required. When the index of the divisor exceeds that of the dividend, borrow 10, and the remainder will be the index of the quotient.

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[*] For the history, nature, and construction of logarithms, see the introduction to Dr. Hutton's set of Mathematical Tables; and for the manner in which they are arranged and are to be taken out in this Work, see the explanation to Table XXIV

EXAMPLES.

Divide	75	Log.	1.87506	Divide	139.2	Log.	2.143639
by	3	Log.	0.47712	by	6	Log.	0.778151
Quotient	25	Log.	1.39794	Quotient	23.2	Log.	1.365488
Divide	9.275	Log.	0.96731	Divide	.01722	Log.	8.236033
by	2.5	Log.	0.39794	by	.07	Log.	8.845098
Quotient	3.71	Log.	0.56937	Quotient	.246	Log.	9.390935

INVOLUTION.

INVOLUTION is the raising of powers from a given root. When a number is multiplied by itself the product is called its 2d power, or *square*; when this product is multiplied by the given number, the last product is called its 3d power, or *cube;* and when the multiplication is again repeated, the 4th power, and so on: The 1st power or number thus raised is called the *root*, and the number of the power to which the given number is raised, the *index* of that power; hence to raise or involve a number to a given power, multiply its logarithm by the index of the power to which it is to be raised, and the product will be the logarithm of the power sought.

When the given number is a decimal Fraction, prefix as many cyphers less one as the index of the product wants of being 10 multiplied by the index of the power.

EXAMPLES

Required the square or 2d power of 15.

Root 15	Log.	1.17609
Index		2
Power 225	Log.	2.35218

Required the cube or 3d power of 2.5

Root 2.5	Log.	0.39794
Index		3
Power 15.625		1.19382

Required the square of .174.

Root	.174	Log.	9.240549
Index			2
Power	.030276	Log.	18.481098

Required the 5th power of .2.

Root	.2	Log.	9.301030
Index			5
Power	.00032	Log.	46.505150

EVOLUTION.

EVOLUTION is the extracting of the root of a given power, or finding a number which when raised to the given power will produce the given number; it is consequently the reverse of involution, and is performed by dividing the logarithm of the number by the index of the power, and the quotient will be the logarithm of the root required.

When the given number is a decimal Fraction, prefix to the index of its logarithm a figure lessened by one than the index of the power, and divide the whole by the index of the power.

EXAMPLES.

Required the square root of 225.

Power	225	Log. 2)	2.35218
Root	15	Log.	1.17609

Required the square or 2d Root of .030276.

Power	.030276	Log. 2)	18.481098
Root	.174	Log.	9.240549

Required the Cube Root of 15.625.

Power	15.625	Log. 3)	1.19382
Root	2.5	Log.	0.39794

Required the 5th Root of .00032.

Power	.00032	Log. 5)	46.505150
Root	.2	Log.	9.301030

RULE OF THREE.

Rule. Add the logarithms of the second and third terms together, and from their sum subtract the logarithm of the first term, and the remainder will be the logarithm of the fourth term.

Or, Add together the arithmetical complement* of the logarithm of the first term, and the logarithms of the second and third terms, the sum, rejecting 10 from the index, will be the logarithm of the fourth term, or proportional number.

EXAMPLES.

If a Ship sail 49.5 Miles in 8 Hours, how many Miles will she run in 24 hours, supposing her to go at the same rate?

As 8 Hours	Log. 0.90309
Is to 49.5 Miles	Log. 1.69461
So is 24 Hours	Log. 1.38021
	Sum 3.07482
	0.90309
To 148.5 Miles.	Log. 2.17173

Or thus,

As 8 Hrs. Arith. Co.	Log. 9.09691
Is to 49.5 Miles	Log. 1.69461
So is 24 Hours	Log. 1.38021
To 148.5 Miles.	Log. 2.17173

Suppose a Watch or Time-keeper gains 14 Seconds in 5 days 6 Hours, how much will it gain in 17 Days 15 Hours?

As 5.25 Days	Log. 0.720159
Is to 14 Seconds	Log. 1.146128
So is 17.625 Days	Log. 1.246129
	Sum 2.392257
	0.720159
To 47 Seconds	Log. 1.672098

Or thus,

As 5.25 Arith. Co.	Log. 9.279841
Is to 14 Seconds	Log. 1.146128
So is 17.625 Days	Log. 1.246129
To 47 Seconds.	Log. 1.672098

Note—See these Examples worked in Decimal Arithmetic.

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* For the method of finding the arithmetical complement of a logarithm, see explanation to Table XXIV.

PRACTICAL GEOMETRY.

DEFINITIONS.

I.

GEOMETRY* is the science or doctrine of extension, or things extended; that is, of lines, surfaces, and solids; or it is that science which treats of the descriptions, properties, and relations of magnitude in general.

II.

A POINT is that which hath no parts, being considered in mathematics as indivisible, and may be expressed by a dot.

III.

A LINE is that which is produced by the motion of a point, and has length without sensible breadth or thickness.

IV.

A STRAIT LINE, or RIGHT LINE, is that which lies evenly between its extremes, without changing its direction, and is the nearest distance between the two points that terminate it, as AB.

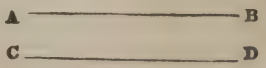
V.

A CURVED LINE is that which is not the nearest distance between its extremes or ends, as CD.

A line is generally expressed by two letters at its extremes.

VI.

PARALLEL LINES are such as are in the same direction, being in every part at the same distance from each other, and which, if infinitely extended, would never meet; as the lines AB, CD.



* Geometry originally meant nothing more than the art of measuring the earth, and is said to have been invented by the Egyptians, who had recourse to it in order to ascertain the artificial boundaries of their land, which was entirely obliterated by the annual inundation of the Nile; but the Science, in its present extended sense, constitutes the principal foundation of all the mathematics.

VII.

A Superficies, or Surface, is that which is conceived to have length and breadth only, without any consideration of thickness, and its boundaries are lines.

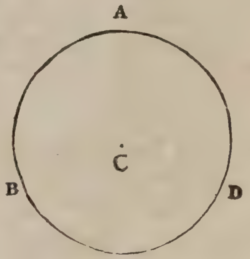
VIII.

A Plane Superficies is that which lies evenly between its extremes, so that a right line may wholly coincide with it in all parts and directions.

IX.

A Solid is that which hath length, breadth, and thickness, and its bounds or extremes are Superficies.

X.



A Circle is a plane figure bounded by a curved line called the Circumference, as ABD, which is in every part equally distant from a point within it called the Center, as C; it is formed by the revolution of a line about one of its extremities, which remains fixed.

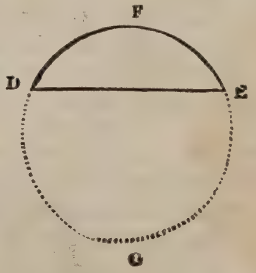
The Circumference of itself is often called the Circle, although properly the circle is the space contained within the circumference.

The Circumference of every circle is usually supposed to be divided into 360 equal parts called degrees, each degree into 60 equal parts called minutes, each minute into 60 equal parts called seconds, and so on.

Degrees, minutes, and seconds, are thus expressed, 40° 32′ 15″; that is 40 degrees, 32 minutes, and 15 seconds.

XI.

An Arch or Arc of a Circle is any part of the Circumference, as DFE.

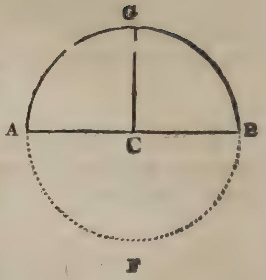


XII.

A Chord is a right line joining the ends of an Arch, as DE; it divides the Circle into two unequal parts called segments; as DFE and DGE.

XIII.

A Diameter is a right line drawn thro' the center of a circle, and terminated at both ends by the Circumference, as ACB; it divides the circle into two equal parts called SEMICIRCLES; as AGB and AFB.



XIV.

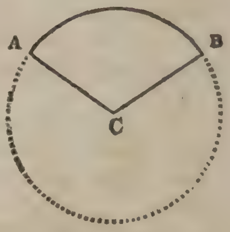
A Quadrant is half a semicircle, or the fourth part of the whole Circle, as ACG or GCB.

XV.

A Radius or Semidiameter is a right line drawn from the center to any part of the Circumference, and is the extent taken in the Compasses to describe a circle, as CA, CG, or CB.

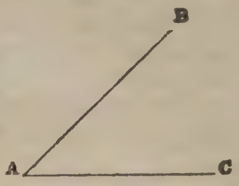
XVI.

A Sector is any part of a Circle, comprehended between two Radii and their included Arch, as ACB.



XVII.

An Angle is the inclination or opening of two lines meeting in one point: the point where they meet is called the ANGULAR POINT, as A; and the lines that include it, the SIDES or LEGS, as AB, or AC.

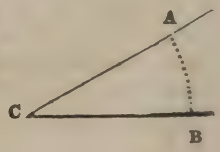


XVIII.

An Angle is sometimes expressed by three Letters, the middle one always denoting the angular point, and the other two the Legs that include it; but generally by the Letter at the angular point only; as the Angle BAC, or the Angle A.

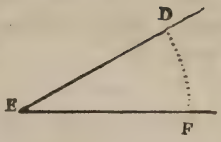
XIX.

An Angle is measured by an Arch of a Circle contained between its Legs, making the angular point the center of the Circle; thus the Arch AB is the measure of the Angle ACB.



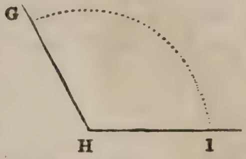
XX.

Angles are said to be equal to each other when the Arches that measure them are equal, as the Angles ACB and DEF.



XXI.

One Angle is esteemed greater or less than another according as the arch between its legs is greater or less; thus the Angle GHI is greater than the Angles ACB or DEF.



From the preceding definitions it will appear evident that the measure of an Angle does not depend on the length of its legs, but on their inclination only; for, as we have just seen, the Angle GHI is greater than the Angles ACB or DEF, although the legs of the latter are longer than those of the former.

XXII.

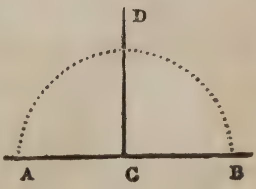
As all Circles are supposed to be divided into 360 equal parts, called degrees, &c. a certain number of these divisions will be contained between the two legs of the Angle; wherefore an Angle is said to measure so many degrees, minutes, &c. as are contained in the Arch between the legs.

XXIII.

The Arch which measures an Angle may be described with any radius; for, since the whole circumference of every circle is supposed to be divided into the same number of parts, it hence follows that the divisions will be greater or less in the same proportion as the whole circumference.

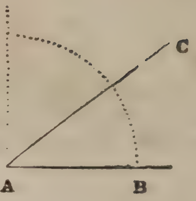
XXIV.

When one right line falls upon another, so as to make the Angles on each side of it equal, it is called a PERPENDICULAR, and the Angles formed by these lines, as the Angles ACD, DCB, are called RIGHT ANGLES; now as the semicircle ADB contains 180 degrees, (the half of 360), all right Angles will contain an Arch of 90 degrees, equal to the fourth part of the whole Circle.



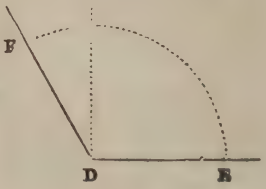
XXV.

An Acute Angle is that which contains less than a right Angle, or 90 degrees, as the Angle CAB.



XXVI.

An Obtuse Angle is that which contains more than a right angle, or 90 degrees, as the Angle FDE.

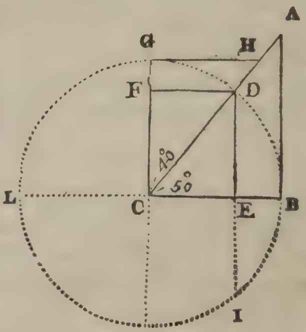


XXVII.

Acute and obtuse Angles are called Oblique Angles.

XXVIII.

The Sine or Right Sine of an Arch, is a right line drawn from one extreme of the Arch, perpendicular to a Diameter drawn to the other extremity, and is equal to half the Chord of double the Arch; thus DE is the Sine of the Arch DB, and is equal to half the Chord DI of double the Arch DBI.



XXIX.

The Versed Sine of an Arch is that part of a diameter contained between the Sine and the Arch; thus EB is the Versed Sine of the Arch DB.

XXX.

The Tangent of an Arch is a right line drawn perpendicular to the end of a diameter passing through one extremity of the Arch, and continued till it meets a right line drawn from the center through the other end of the Arch; thus AB is the Tangent of the Arch DB.

XXXI.

The Secant of an Arch is a right line drawn from the center through one end of the Arch till it meets the Tangent drawn from the other end: thus CA is the Secant of the Arch DB.

XXXII.

The COMPLEMENT of an Arch is what it wants of a right Angle, or 90 degrees; thus GD is the complement of DB, or DB of DG.

XXXIII.

The SUPPLEMENT of an Arch is what it wants of two right Angles, or 180 degrees; thus LD is the Supplement of DB, or DB of LD.

XXXIV.

The CO. SINE, CO. TANGENT, CO. SECANT, and CO. VERSED SINE of an Arch, is the Sine, Tangent, Secant and Versed Sine of the Complement of that Arch; Co. being a contraction of the word Complement: thus DF is the Co. Sine, GH the Co. Tangent, CH the Co. Secant, and GF the Co. Versed Sine, of the Arch DB; being the Sine, Tangent, &c. of the Arch DG, the Complement of the Arch DB.

The Sine, Tangent, and Secant of an Arch, as of DB, is likewise the Sine, Tangent, and Secant of the Supplement of that Arch, as of LD.

XXXV.

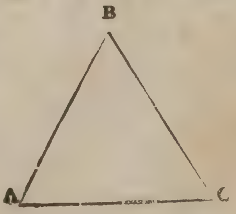
An Angle being measured by an Arch of a Circle, (see Def. XIX.) the Sine, Tangent, &c. of an Arch is the Sine, Tangent, &c. of the Angle which is measured by the Arch, or of the degrees and minutes, &c. that the Arch contains; hence, supposing the Arch DB, which measures the Angle DCB, to contain 50 degrees, the lines DE, AB, AC, and EB, will be respectively the Sine, Tangent, Secant, and Versed Sine of the Angle ACB, or of 50 degrees; and consequently the Co. Sine, Co. Tangent, Co. Secant, and Co. Versed Sine, of the Angle GCD, or of 40 degrees, the Complement of 50 degrees.

XXXVI.

A PLANE TRIANGLE is a figure bounded by three right lines, and contains three Angles, of which there are several kinds, both with respect to their sides and Angles.

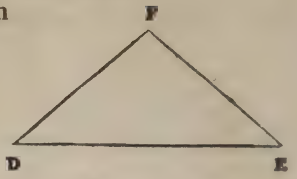
XXXVII.

An EQUILATERAL TRIANGLE is that which has its three sides equal to one another, as ABC.



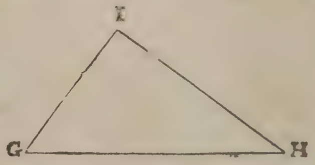
XXXVIII.

An Isosceles Triangle is that which has only two sides equal, as DEF.



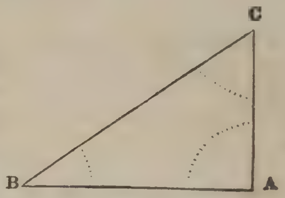
XXXIX.

A Scalene Triangle is that whose sides are all unequal, as GHI.



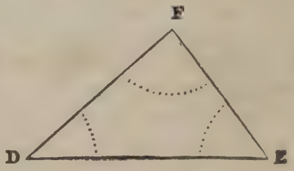
XL.

A Right Angled Triangle is that which has one of its Angles right, or containing 90 degrees, as the Angle A; the side opposite the right Angle is called the Hypothenuse, as BC; and the other two sides are called Legs, that which stands upright, the Perpendicular, as AC, and the other the Base, as BA.



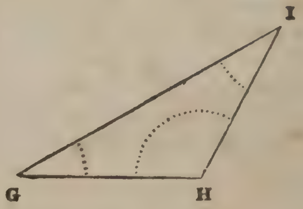
XLI.

An Acute Angled Triangle is that which has all its Angles Acute, as DEF.



XLII.

An Obtuse Angled Triangle is that which has one of its Angles obtuse, as the Angle H in the Triangle GHI.



XLIII.

All Triangles that are not right Angled, whether they are acute or obtuse, are, in general terms, called Oblique Angled Triangles; without any other distinction.

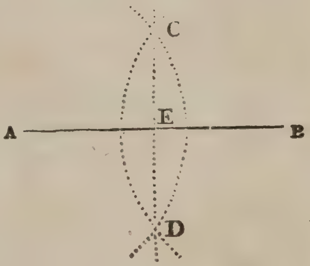
PROBLEMS.

PROBLEM I.

To divide a given right line AB *into two equal parts.*

Take any extent in the Compasses greater than half the line AB, and with one foot in B describe an Arch; with the same Radius, and one foot in A, describe an Arch cutting the former in C and D; through C and D draw a right line, and this line will divide the given line AB into two equal parts at the point E.

In this manner any Arch of a Circle may be divided into two equal parts.

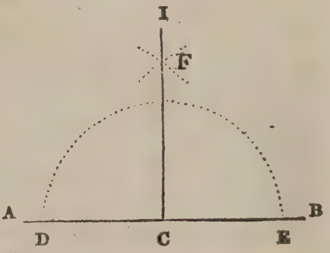


PROBLEM II.

From a given point C, *in a given right line* AB *to raise a perpendicular.*

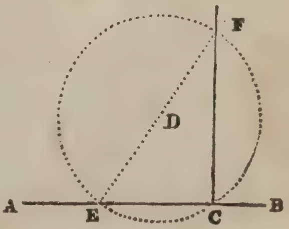
CASE 1st. When the given point C is near the middle of the line AB.

With one foot of the Compasses in C, at any distance, draw an Arch cutting the line AB in D and E, from the points D and E, with any distance greater than CE or CD, describe two Arches cutting each other in F; thro' the points F and C draw the line IC, and it will be perpendicular to the given line AB.

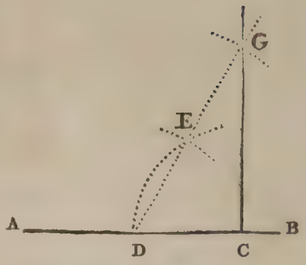


CASE 2d. When the given point C is at, or near, the end of the line AB.

Take any point out of the line, as D, and with the distance DC describe a Circle, cutting the line AB in E and C; through the center D and the point E, draw the right line EF cutting the Circle in F; then a line drawn through F and C will be the perpendicular required.



Or thus: Describe the Arch DE at any distance from C and with one foot of the Compasses in D, with the same extent, describe an Arch cutting the Arch DE in E; from this point, keeping the same extent in the Compasses, draw the Arch G; through D and E draw the right line DG, cutting the Arch in G; then draw a right line through G and C and it will be the perpendicular required.

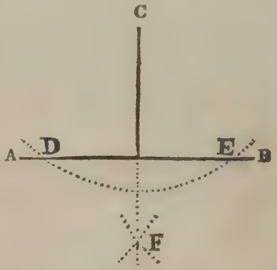


PROBLEM III.

From a given point C *to let fall a perpendicular on a given right line* AB.

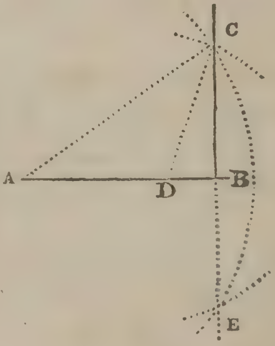
CASE 1st. When the point C is nearly opposite the middle of the line AB.

With one foot of the Compasses in C describe an Arch cutting the line AB in D and E; from these points, at any distance, describe two Arches cutting each other in F; through the points C and F draw a right line, and it will be perpendicular to the given line AB.



CASE 2d. When the given point C is nearly opposite to the end of the line AB.

Place one foot of the Compasses in any part of the given line, as at A, and with the distance AC describe the Arch CE; then, from any other part of the given line nearly under the point C, as at D, with the distance DC describe a small Arch cutting the Arch CE in E, then a line drawn through the points C and E will be perpendicular to the line AB.

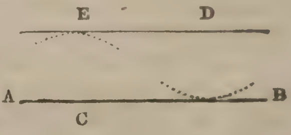


PROBLEM IV.

To draw a right line parallel to a given right line AB.

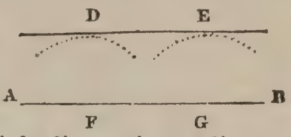
CASE 1st. When the parallel line is to pass through a given point D.

Take the nearest distance between the given point D and the right line AB; with that distance set one foot of the Compasses



on any part of the line AB, as at C, and describe the Arch E; from the point D draw a line so as just to touch the Arch E without cutting it, and that line will be parallel to the given line AB through the given point D.

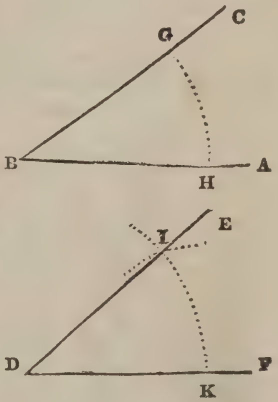
CASE 2d. When the parallel line is to be at a given distance from the right line AB.



With the given distance in the Compasses, describe two Arches D and E from any two points as F and G in the given right line; then a line DE drawn just touching the two Arches without cutting them, will be parallel to the given line AB.

PROBLEM V.

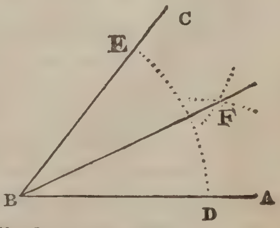
At a given point D *in the right line* DF *to make an angle* EDF *equal to a given Angle* CBA.



With one foot of the Compasses in B, at any distance describe the Arch GH; through D draw the line DF, and, keeping the same extent in the Compasses, place one foot in D and describe the Arch in IK; then take the distance GH, apply it to the Arch IK from K to I, and through the points D and I, draw the line DE; the Angle EDF will then be equal to the Angle CBA, as was required.

PROBLEM VI.

To divide a given Angle ABC *into two equal parts.*

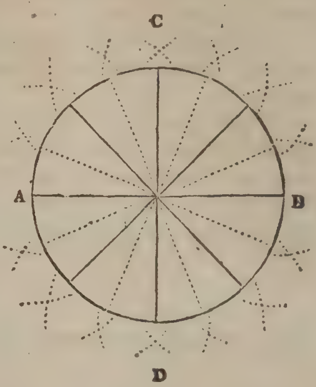


From the angular point B with any extent in the Compasses describe the Arch DE; from D and E, with the same or any other extent, describe two Arches cutting each other in F; through the points B and F draw a right line, and it will divide the Angle into two equal parts.

In the same manner any given Arch of a Circle is bisected when the center of the Circle is given.

PROBLEM VII.

To divide a Circle ABCD *into two, four, eight, sixteen, thirty-two, &c. equal parts.*

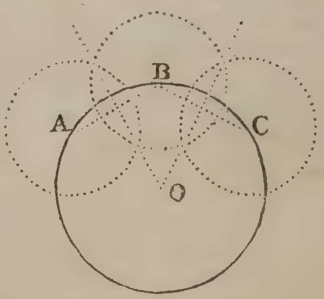


Draw a Diameter AB, and it will divide the Circle into two equal parts; from the points A and B describe the Arches at C and D, a line drawn through these will divide the Circle into four equal parts; then bisect the Arches AC, CB, &c. by the last Problem, and the Circle will be divided into eight equal parts, and so on by continual bisections.

This Problem is useful in constructing the Mariner's Compass.

PROBLEM VIII.

To draw the circumference of a Circle through any three given points A, B, C, *not situated in a right line.*

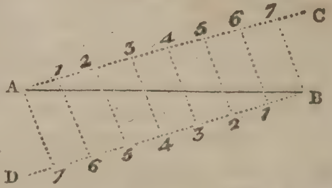


Draw lines joining AB and BC, and bisect them by lines meeting in O, as directed in Problem I.; then from O at the distance of any one of the points, as OA, describe a Circle, and it will pass through the other points B and C as required.

In this manner the center of a Circle may be found; for taking any three points in the Circumference, and proceeding as before directed, the lines meeting at O will give the center required.

PROBLEM IX.

To divide a given line AB *into any proposed number of equal parts.*



Let it be required to divide the line AB into seven equal parts; from one end A of the given line AB draw a right line AC, making any Angle with AB, and from the other end B draw a line BD parallel to AC; on each of the lines AC, BD, beginning at A and B, set off as many equal parts as AB is to be divided into, viz. seven; then lines drawn from A to 7, 1 to 6, 2 to 5, 3 to 4, &c. will divide the given line into seven equal parts.

PROBLEM X.

To construct Scales of equal Parts.

The simplest Scale of equal parts is made by drawing a strait line and dividing it with a pair of Compasses into as many primary divisions as convenient, which if the line is of a definite length may be done by Prob. IX., and subdividing one of these decimally, or into ten equal parts; then each of the former may represent 10 units, as leagues, miles, &c. and in that case the latter will represent one of these units: or if the larger divisions are supposed to be 100, then the subdivisions will be tens, and so on: suppose, for example, it were required to set off from the Scale 25 or 250; set one foot of a pair of Compasses on 2 among the primary divisions, and the other on the 5th subdivision; then this extent will represent 25 or 250 miles, leagues, or any other measure of length as it may be required.

There are frequently several of these Scales drawn parallel to each other of different lengths on a flat rule, (as Fig. 1, Plate I.;) they are divided into as many equal parts as the length of the rule will admit; the numbers placed on the right hand shewing how many parts in an inch each scale is divided into. These Scales are sometimes subdivided duodecimally to adapt them to feet and inches when used in Mensuration, or sexagesimally to represent degrees and miles on Maps and Charts.

But the most correct Scale of equal parts is the DIAGONAL SCALE, (Fig. 2, Plate I.) the larger divisions of which are commonly an Inch or half an Inch, and sometimes a quarter of an inch, subdivided into one hundred equal parts; to construct this scale draw eleven equidistant parallel lines; divide the upper of these lines AE into such a number of equal parts as the Scale is intended to contain; from each of these divisions draw perpendicular lines through the eleven parallels to the line CF; subdivide the first of these divisions AB and CD into ten equal parts, and from the point C to the first division in the line AB, draw a diagonal right line, and lines parallel to this through each succeeding subdivision; then will each diagonal line in passing from the line BA to DC be one tenth of the subdivisions further from the line DB at the points where they intersect each succeeding parallel from BA to DC, that is, one hundredth of the larger divisions, by which means it is divided into one hundred equal parts.

If therefore the larger divisions be accounted as units, the first subdivisions will be tenths, and the second, marked by the diagonals upon the parallels, hundredth parts; but if we suppose each of the larger divisions to represent ten, then the first subdivisions will be units, and the second tenths; or if the larger divisions be hundreds, then will the first subdivisions be tens, and the second units; so that the value of the subdivisions depend on that of the larger divisions.

The numbers 376, 37.6, 3.76, may therefore all be expressed by the same extent of the Compasses: thus setting one foot in the line marked 3 of the larger divisions, on the sixth parallel, and extending the other along the same parallel to the seventh diagonal, that distance will be the extent required; for if the three larger divisions be taken for 300, seven of the first subdivisions will be 70, which upon the sixth parallel, taking in six of the second subdivisions for units, makes the whole number 376; or if the three larger divisions be taken for 30, seven of the first subdivisions will be seven units, and the six subdivisions, upon the sixth parallel, will be six tenths of a unit: lastly, if three larger divisions be esteemed as only 3, then will the first subdivisions be seven tenths, and the six second subdivisions be the six hundredth parts of a unit.

PROBLEM XI.

To construct Lines of Chords, Sines, &c.

Describe a semicircle ADB with any convenient radius, (Fig. 3, Plate I,) and upon the center C, erect the perpendicular CD, continued at pleasure to F; through B draw BE parallel to CF, and draw the right lines AD and DB. Divide the quadrant DB into 9 equal parts, and with one foot of the Compasses in B and the distances B 10, B 20, &c. transfer them to the right line BD, which will be a LINE OF CHORDS.

Divide the quadrant AD into 8 equal parts, and with one foot of the Compasses in A, and the distance A 1, A 2, &c. transfer them to the right line AD and it will be a LINE OF RHUMBS, containing eight points of the Compass.

From the points 10, 20, 30, &c. in the Arch BD, draw lines parallel to DC which will divide the radius CB into a LINE OF SINES, reckoning from C to B, or of VERSED SINES, if it be numbered from B to C; which may be continued to 180, if the same divisions be transferred to the line CA, the other half of the diameter.

From the center C draw right lines through the several divisions of the quadrant DB until they cut the line BE which will become a LINE OF TANGENTS*.

Transfer the distances between the center C and the divisions on the line of Tangents, to the line DF and these will give the divisions of the LINE OF SECANTS, which must be numbered from D towards F.

From A draw right lines through the several divisions of the Arch BD, and they will divide the radius CD into a LINE OF SEMITANGENTS, which are to be marked with the corresponding figures of the Arch DB.

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* From the construction of the lines of Chords, Sines, and Tangents, it is obvious that the Chord of 60°, the Sine of 90°, and the Tangent of 45°, are all equal to the radius of the Circle.

CONSTRUCTION OF THE LINES
ON THE
PLANE SCALE, &c.

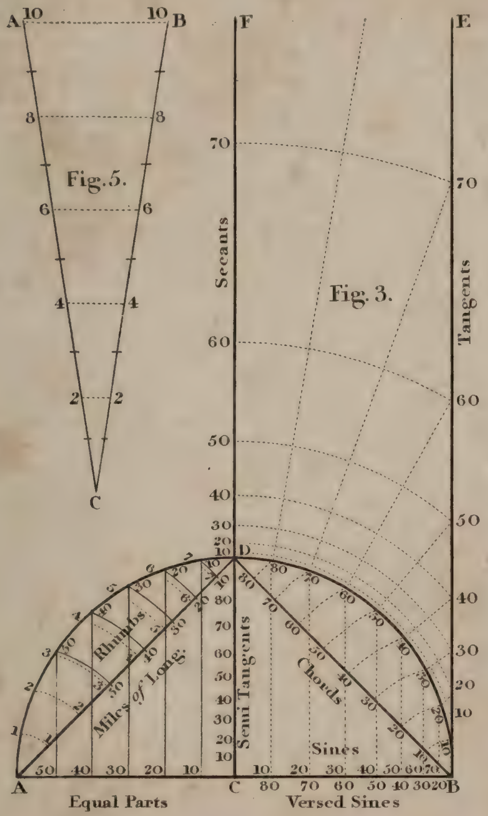


Fig. 5.

Fig. 3.

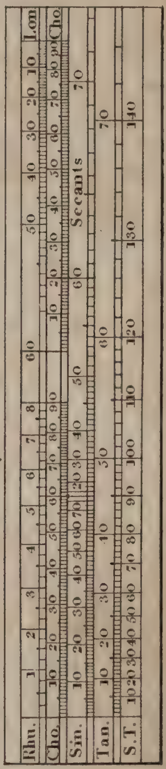


Fig. 4.

Fig. 1. *COMMON SCALE OF EQUAL PARTS.*

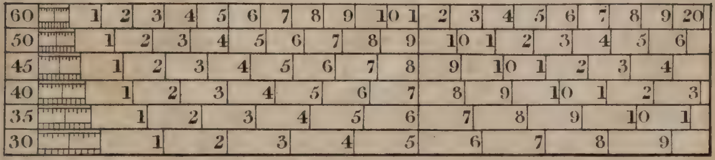
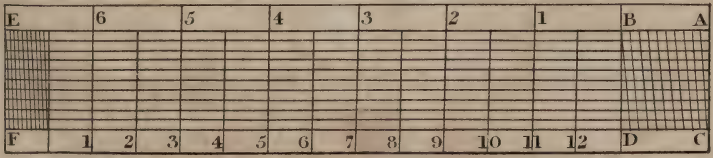


Fig. 2. *DIAGONAL SCALE OF EQUAL PARTS.*



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Divide the radius AC into 6 equal parts; through each of these draw lines parallel to CD, intersecting the Arch AD, then, with one foot of the Compasses in A, and the distances of the Arch A 50, A 40, &c. transfer these to the right line AD, and it will give the divisions of the LINE OF LONGITUDE.

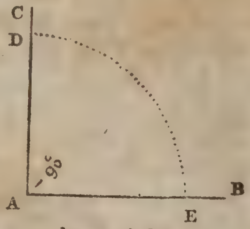
If this line be laid upon the Scale close to the line of Chords, so that 60 on the line of longitude be opposite o on the Chords, and any degree of latitude be counted on the Chords, there will stand opposite to it, on the line of longitude, the miles contained in one degree of longitude in that latitude; the measure of a degree at the Equator, being 60 miles.

In the Figure the divisions are given only to every tenth degree, and each point of the Compass, which is sufficient to explain the method of construction; but in Figure 4, these lines are graduated to degrees, and the Rhumbs to quarters, and placed parallel as exhibited on one side of a flat Rule, which, with the scale of equal parts on the other side, constitutes the instrument called a PLANE SCALE.

Besides the lines already mentioned, there are frequently on the Plane Scale a line of leagues and a few other lines, which are only so many scales of equal parts, each having the equal divisions of different lengths, for the more readily laying down lines and figures of different lengths and magnitudes.

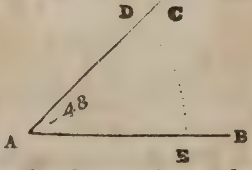
PROBLEM XII.

To make an Angle that shall contain any proposed number of degrees.



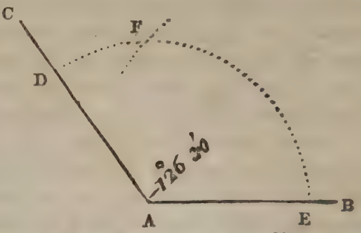
CASE 1st. When the given Angle is right, that is, contains 90 degrees.

Draw the line AB, and from the Scale take the extent of the Chord of 60 degrees in the Compasses; then set one foot of the Compasses in A, and with the other describe the Arch ED, and set off thereon, from E to D, the distance of the Chord of 90°; through A and D draw the right line AC, then will the Angle BAC be a right Angle. By this method a perpendicular may easily be raised on a given line, since the Angle formed by one line that is perpendicular to another, is always a right Angle.



CASE 2d. When the Angle is to be acute; suppose one that shall contain 48 degrees.

Draw the line AB, and with one foot of the Compasses in A, (the Chord of 60 degrees being taken as before), draw the Arch ED, on which set off 48 degrees from E to D; through A and D draw the right line AC; then will the Angle BAC be made, containing 48 degrees, as was required.



CASE 3d. When the Angle is to be obtuse; suppose one that shall contain 126° 30′.

Draw AB, and from the point A with the Chord of 60°, as before, draw the Arch DE, and, as the divisions on the scale extend no further than 90°, first set off 90° from E to F; then set off the remainder, or excess above 90°, that is, 36° 30′, from F to D; through A and D draw the line AC, and the Angle BAC will contain 126° 30′.

PROBLEM XIII.

To measure a given Angle BAC.

With one foot of the Compasses in the angular point, and with the Chord of 60 degrees, describe the Arch DE (see the Figures in Problem XII.) cutting the legs in D and E; then the distance DE applied to the line of Chords, from the beginning, will shew the measure of the Angle BAC, if it contains less than 90 degrees; but when the Arch exceeds that quantity, take 90 degrees from the line of Chords, and set it off from E to F, then measure the excess DF, and their sum will give the measure of the Angle required.

The construction of Triangles will be explained in Trigonometry; but before the Learner begins that subject, we would recommend him, if he have time, to study the Use of Gunter's Scales, and the Sector, as these Instruments will afford him easy, elegant, and concise methods of resolving Triangles.

DESCRIPTION AND USE

OF

GUNTER'S SCALES.

OF THE COMMON GUNTER.

THIS Instrument is a flat Rule, usually two feet in length, and about an inch and a half broad, having on one side Equal Parts, Rhumbs, Chords, &c. as on the Plane Scale; and on the other the logarithms of these numbers; hence the lines on this side are called logarithmic lines: they were invented by Mr. Edmund Gunter, who applied the logarithms of Numbers, and of Sines and Tangents to strait lines, by taking the lengths expressed by the figures in those logarithms from a scale of equal parts, and applying them to lines, as laid down on the Rule.

On the logarithmic side of the common Gunter are the eight following Lines.

1. *A line of Sine Rhumbs*, marked S. R., which contains the logarithms of the natural Sines of every point and quarter point of the Compass, numbered from the left hand towards the right, with 1, 2, 3, 4, 5, 6, 7, 8, where a brass pin is fixed.

2. *A line of Tangent Rhumbs*, marked T. R., corresponding to the logarithms of the tangent of every point and quarter point of the Compass. This line is numbered 1, 2, 3, 4, from left to right and back again with 5, 6, 7, from the right towards the left. To take off any number of points below 4, we must reckon from the 1 towards the right hand, but any number of points above 4 we count towards the left hand.

3 *A line of Numbers*, marked NUM., on which most of the others depend, containing the logarithms of Numbers, and is figured from the left hand of the Scale towards the right to 1 or 10, near the middle of the Scale; these divisions are subdivided into ten unequal parts, and these again into ten, five, or two parts, as room will permit; the whole of these divisions and subdivisions are repeated from the middle towards the right hand, being exactly of the same lengths, but ten times the value of the corresponding numbers in the first part.

If the 1 at the beginning of the line represents 1 unit, the next primary division, marked 2, will represent 2 units, and the middle 1 will be 10, the following 2 will be 20, the 3 will stand for 30, and so on, the 10 at the right hand representing 100. If the left hand 1 stands for 10, then the 2 will stand for 20, the 3 for 30, the middle 1 for 100, the following 2 for 200, and the 10 on the right hand for 1000; in like manner if the first 1 be esteemed 1 tenth, the next following 2 will be 2 tenths, the middle 1 will be 1 unit, the next 2 will be 2 units, and the 10 at the end will be 10 units. Again, if the first 1 be counted 1 hundredth part, the next 2 will be 2 hundredth parts, the middle 1 will stand for 10 hundredth parts, or 1 tenth, the next 2 for 2 tenths, and the 10 at the end will stand for 1 unit, or whole number.

It is manifest that the value of the subdivisions must depend on that of the primary divisions; for, suppose the first 1 at the left hand be reckoned for 1 unit, then the first following principal subdivision will be 1 tenth, the second 2 tenths, and so on to the next primary division, which will represent 2 units; reckoning on in the same manner till you come to the middle 1, which will represent 10, then the next following principal subdivision will be 11, the next 12, where a brass pin is fixed: the next primary division 20, and so on to 100: and in the same way will the smaller subdivisions be valued.

As this line is of great importance, we shall add a few examples to render what has been said the more clear. Suppose the point representing 25 be required:—the primary division 2 on either half is to be reckoned for 20, then counting forwards to the right, to the fifth principal subdivision, that point will represent 25, or 250, or 2500, &c. Again, let the point representing 146 be required. Here the 1 at the beginning, or in the middle, may be esteemed 100, the fourth principal subdivision on the right will then be 140, and because the interval between 140 and 150 is divided into 5 parts, each will be valued as 2, therefore, counting forwards 3 of these latter subdivisions, that point will represent 146.

Once more; suppose the place of 1785 be required:—the one at the beginning or middle is to be taken as 1000, the seventh following principal subdivision will be 1700; the fourth following smaller subdivision will be 1780, and the fourth part of the next smaller subdivision will be the point representing 1785.

4. *A line of Sines*, marked Sin., beginning at the left hand, and numbered towards the right at each degree as far as 10, and then at each 10th degree to 90; the subdivisions under 10 degrees are usually 10 minutes; from 10 to 20 each is half a degree; from 20 to 30 each is a degree; from 30 to 80 each is 2 degrees; and from 80 to 90 each is 5 degrees.

5. *A line of Versed Sines*, marked v. s.; it is numbered from the right towards the left, at each 10th degree as far as 160; the subdivisions from 20 to 90 are usually each two degrees; from 90 to 130, one degree, and from 130 to the end, half a degree.

6. *A line of Tangents*, marked Tan.; it is numbered from the left hand towards the right as far as 45 dgrees, which is equal to Radius or the Sine of 90 degrees; and, since the Log. Tangent of an Arch above 45 degrees is the arithmetical complement of the tangent of an Arch as much less than 45 degrees, the same division represents 40 or 50 degrees, 30 and 60, and so on; for if the line of tangents were continued beyond 45 on the right, the divisions would be exactly the same length only reversing the order; therefore, instead of such continuation, it is more convenient to reckon the degrees above 45, backwards, or from right to left, observing at the same time that the degrees above 45 are to be supposed, when using the line, increasing towards the right hand, as in the other parts of the line.

The Subdivisions on this line are nearly the same as on the line of Sines; indeed, these as well as the other lines are variously subdivided on different Rules, according to the accuracy and goodness of the Instrument.

7. *A line of Meridional Parts*, marked MER., reckoned from right to left, each larger division representing 10 degrees, and the smaller each 1 degree, or 60 meridional miles.

8. *A line of equal Parts*, marked E. P., numbered from right to left, each large division representing 10 degrees of the Equator, or 600 miles. The first of these divisions is sometimes divided into 10 equal parts, each representing a degree, or 60 miles, and these again into halves or quarters of 30 or 15 miles each.

USE OF THE LINE OF NUMBERS.

Multiplication is performed on this line by extending the Compasses from 1 to either of the factors*, and that extent will reach from the other factor to the product.

Suppose, for example, it were required to find the product of 16 multiplied by 5: Set one foot of the Compasses in 1, and the other in 5, then that extent will reach from 16 to 80, the product required.

When the product contains four figures, the fourth cannot be well ascertained by the Scale, but it may be easily found by multiplying the unit figures of the factors, and the unit figure of their product will be that of the product required. For example, suppose it were required to find the product of 22 by 16; the extent from 1 to 16 will reach from 22 to about 350, but as the divisions are too small to distinguish the last figure, therefore multiply 2 by 6, which will give the product 12; hence the product required is 352.

Division being the reverse of Multiplication, extend from the divisor to 1, and that extent will reach from the dividend to the quotient.

Example—divide 80 by 5. Extend from 5 to 1, and that extent will reach from 80 to 16, the quotient required.

To reduce a Vulgar Fraction to a Decimal, extend from the denominator to the numerator, and that extent will reach from 1 to the decimal fraction required.

Example—Required the decimal fraction equal to $\frac{3}{4}$. Extend from 4 to 3, and that extent will reach the same way from 1 to .75, the decimal required.

To perform the Rule of Three—State the question so that the first and third terms may be of the same name; then the fourth term will be of the same name with the second, and greater or less than the second, as the third is greater or less than the first; then extend the Compasses from the first to the third term, and that extent will reach from the second to the fourth term.

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* The factors are numbers multiplied, of which one is called the Multiplier, and the other the Multiplicand.

Example—If a Ship sail at the rate of 26 miles in 3 hours, how many miles will she sail in 24 hours?

Here, as 3 hours is to 26 miles, so is 24 hours to the Answer; therefore, extend from 3 to 24, and that extent will reach from 26 to 208, the miles required.

To find the area, or superficial content of a square, or rectangle, extend from 1 to the breadth, and that extent will reach from the length to the superficial content.

Example—Suppose a board or plank measures 18 inches broad, and 25 feet in length, required the superficial content.

Extend from 1 to 1.5, (= 1 foot 6 inches,) and that extent will reach from 25 feet to 37.5, or 37 feet 6 inches, the contents required.

To find the solid contents of a Bale, Box, Chest, &c. or any other rectangular solid, extend from 1 to the breadth, and that extent will reach from the length to a fourth number; then extend from 1 to the depth, and that extent will reach from the fourth number to the solid contents.

Example—Required the solid contents of a Box measuring 3 feet broad, 5.5 feet long, and 2 feet in depth.

Extend from 1 to 3, and that extent will reach from 5.5 to 16.5; then extend from 1 to 2, and that extent will reach from 16.5 to 33 feet, the solid contents.

USE OF THE LINES OF SINES AND TANGENTS.

These lines are used with the line of Numbers in working proportions in Trigonometry, by the Rule above, as will be fully exemplified when we treat on that subject.

USE OF THE LINE OF VERSED SINES.

This line is used with the line of Sines in resolving a Spherical Triangle when the three sides are given to find the Angles, or the three Angles, to find the Sides, as will be explained in the Methods of working an Azimuth.

USE OF THE LINES OF MERIDIONAL AND EQUAL PARTS.

These lines are always used together, and only in Mercator's Sailing, or in constructing a Mercator's Chart; when the Meridional Parts answering to a given Latitude is required, it is found by taking the extent from the beginning of the line of Meridional Parts to the given Latitude; this extent being applied to the line of equal parts, will give, in degrees, the Meridional Parts required. Or, if the Meridional difference of Latitude between two places be wanted, the extent from one Latitude to the other on the line of Meridional Parts will give, when applied to the line of equal parts, the Meridional Difference of Latitude in degrees, which are to be reduced to miles.

OF THE SLIDING GUNTER.

This Instrument is nearly of the same dimensions with the common Gunter, but consists of three pieces of wood; the extreme pieces being connected by thin plates of brass at each end, and the third made to slide in grooves between them. The lines on this Scale are constructed and graduated as on the Plane Scale and common Gunter; we shall therefore only remark here, that there are two lines of Numbers, Sines, and Tangents, one on the fixed part of the Scale, and the other on the slide; and that there is likewise a third line of Numbers on the Slide opposite a line of Sine Rhumbs.

USE OF THE LINE OF NUMBERS.

To perform Multiplication by these lines, set 1 on the sliding line to one of the factors on the fixed line, then opposite the other factor on the slide will be found the product on the fixed line. Example—To find the product of 16 multiplied by 5, draw out the slide until 1, on its line of Numbers, coincides with 5 on the fixed line, then opposite 16 on the sliding line, will be 80 on the fixed line.

Division is performed by drawing out the slide until the divisor on its line coincides with the dividend on the fixed line; then opposite to 1 on the sliding line will be the quotient on the fixed line. Example—to divide 124 by 4, set 4 on the sliding line to coincide with 124 on the fixed line; then opposite to 1 on the slide, will be 31, on the fixed line, which is the quotient required.

To work the Rule of Three, let the question be stated so that the first and third terms may be of the same name, then the fourth term will consequently be of the same name with the second, and greater or less than the second, as the third is greater or less than the first. Now, set the first term on the sliding line opposite to the third term on the fixed line, and the fourth term will be found on the fixed line opposite to the third term on the sliding line. Examples—If 3 yards of Cloth cost 21 Shillings, what will be the value of 27 yards? Now, as 3 yards : 21 Shs. : : 27 yds. : the Answer: therefore set 3 on the sliding line of numbers to 27 on the fixed line, then opposite to 21 on the sliding line will be found 189 on the fixed line, the fourth term or number of shillings required; equal to 9 Pounds 9 Shillings. Again; suppose a Ship sails 170 Miles in 24 Hours, at what Rate is that per Hour? As .24 Hrs. : 170 Miles : : 1 Hour : the Answer. Set 24 on the Sliding line of Numbers to 1 on the fixed line; then opposite to 170 on the sliding line is $7\frac{1}{10}$ on the fixed line, the Miles and parts that the Ship sails per Hour.

The Use of the Lines of Sines and Tangents on this Rule will be fully explained when we treat on Trigonometry, and the various Sailings.

DESCRIPTION AND USE

OF THE

SECTOR.

THIS Instrument is formed of two equal rules or legs, moveable about a center or joint, on the faces of which are drawn several lines or Scales, some proceeding from the center, called SECTORAL LINES, and others parallel to the edge of the rules, similar to those laid down upon a common Gunter.

The Sectoral Lines are drawn twice on the same face of the instrument, that is, once on each leg; those on one face are, 1. Two Scales of equal parts marked LIN. or L.; each of these scales, from the great extensiveness of its use, is called the LINE OF LINES.—2. Two Lines of Chords, marked CHO. or C. 3. Two Lines of Secants, marked SEC. or S. 4. Two Lines of Polygons, marked POL. Upon the other face the sectoral lines are, 1. Two Lines of Sines, marked SIN. or S. 2. Two Lines of Tangent marked TAN. or T. 3. Between the lines of Tangents and Sines, two other lines of Tangents, marked *t*, to a less radius, to supply the defect of the former, and extending from 45 to about 75 degrees.

The lines of Chords, Sines, Tangents, and Secants, are constructed upon the same principle as those on the Plane Scale, making the length of the line of Chords the Radius of the Circle, (See Geom. Prob. XI.)

Each pair of the Sectoral Lines (except the line of Polygons) are numbered from the center, and so disposed as to make equal Angles at the center, consequently at whatever distance the Sector be opened, the Angles will always be respectively equal; that is, the distance between 10 and 10 on the line of lines, will be equal to 60 and 60 on the lines of Chords, 90 and 90 on the lines of Sines, and 45 and 45 on the lines of Tangents.

The other lines on the Sector being for the most part such as are usually drawn upon the Gunter's Scale, which have already been described, it will be unnecessary here to enumerate them; we shall therefore only observe that the logarithmic lines, being placed partly on one leg and partly on the other, are to be used with the legs fully opened.

The Use of the Sectoral lines is founded on a property of similar Triangles, namely, that their corresponding sides are proportional. Let CB, CA, (Fig. 5, Plate I.) represent a pair of Sectoral Lines, forming the Angle ACB; divide them each into any number of equal parts, as ten for instance, and draw lines to the corresponding numbers on each line, as from 2 to 2, 4 to 4, &c. These lines will form a series of Triangles, as C 2 2, C 4 4, &c. all similar to the Triangle CAB, therefore it will be, as C 2 is to CA, so is 2 2 to 10 10, or AB; and as C 2 is to 2 2, so is CA to AB, and so on for the other corresponding lines.

Hence also if the lines CA, CB represent the lines of Chords, Sines, Tangents, or Secants; and if CA be the radius, and the line C 2 the Chord, Sine, Tangent, or Secant, of any proposed number of degrees, then the line 2 2 will be the Chord, Sine, &c. of the same number of degrees to the radius AB.

We shall now proceed to explain some of the most important uses to which the Sectoral lines may be applied; previous to which it will be necessary to observe, that in all operations the distances are to be taken with a pair of Compasses from the innermost of the three lines which bound the divisions, that being the line proceeding from the center; it is likewise to be understood, that the measure taken from the center to any part of a sectoral line, is called a *lateral distance*, and that the measure taken from any point in one line to its corresponding point in a line of the same name, is called a *transverse*, or *parallel distance.*

USE OF THE LINES OF LINES.

1. *To divide a given line into any number of equal parts:* for example suppose 9. Take the length of the given line in the Compasses, and make it a transverse distance from 9 to 9, the number of parts proposed; then will the transverse distance of 1 and 1 be one of the equal parts, or the 9th part of the whole; and the transverse distance of 2 and 2 will be 2 of the equal parts, or $\frac{2}{9}$ of the whole line, and so on.

Note—When the line to be divided is too long to be applied to the legs of the Sector, take some aliquot part of it, as the half, the third, &c. and double or triple the lengths of the transverse distances taken from the Sector.

2 *To divide a given line into any number of parts that shall be in any assigned proportion;* as, suppose three parts, in the proportion of 2, 3, and 4. Make the given line a transverse distance to 9, the sum of the proposed numbers 2, 3, 4; then the transverse distances of these numbers severally will be the parts required.

3. *To find a fourth proportional to three given lines or numbers*; as, suppose to 8, 4, and 6. Take the lateral distance of 4 in the Compasses, and make it the transverse distance of 8, then the transverse distance of 6, extended from the center, will reach to the fourth proportional 3. If a Ship sails 36 miles in 4 hours, what distance will she sail in 7 hours? Open the Sector till the transverse distance of 4 and 4 is equal to the lateral distance 36, then the transverse distance of 7 laid off from the center will give 63, the fourth proportional.

Suppose three lines AB, CD, and EF, given to find a fourth proportional. Take the length of the line AB in the Compasses, and placing one foot in the center, mark what point or division the other foot falls on; open the Sector till the parallel distance between that point and the corresponding one on the other leg is equal to the line CD; then EF taken in the Compasses and laid off as a lateral distance, the corresponding transverse distance will be the length of the line required.

Let it be required to reduce a Chart drawn on a scale of 5 inches to a degree, to a scale of 3 inches to a degree. Make the transverse distance from 5 to 5 equal to the lateral distance of 3; the legs of the Sector being kept at this angular position, any measure taken from the Chart being laid off as a lateral distance, the corresponding transverse distance will be the measure to be laid down upon the reduced Chart.

4. *Having a line containing any given number of equal parts, to find the length of a line containing any other number of the same parts.*

Suppose a Chart to be drawn on a scale of 5 miles to 3 inches; required the length of any other number of miles upon the same scale. Make the transverse distance of 5 and 5 equal to 3 inches; the legs of the Sector being kept at this angular position, the transverse distance of any other number, within the limits of the Sector, will be the length of the number of miles required.

5. *Having the number of parts contained in any given line, to find the number of the same parts contained in another line.*

Suppose the length of one side of a Triangle measure 30, what are the measures of the other Sides? Take the length of the given Side in the Compasses, and apply it transversely from 30 to 30; to this opening of the Sector apply the length of the other Sides transversely, so that the points may fall upon corresponding divisions, and these will shew the measure of the Sides required.

USE OF THE LINES OF CHORDS.

1. *To protract or lay down an Angle of any given number of degrees.* At any opening of the Sector take the transverse distance of 60°, with which extent describe an Arch; then take the transverse distance of the proposed number of degrees, and apply it to that Arch: through the extremities of this distance on the Arch, draw two lines from the center, and they will form the Angle required. When the Angle exceeds 60°, lay it off at twice or thrice.

In this manner any number of degrees may be laid off on the circumference of a given Circle, making the transverse distance of 60° equal to the Radius of the Circle.

2. *To measure any given Angle.* With any Radius describe an Arch from the angular point, and set that radius transversely from 60 to 60; then take the length of the intercepted Arch in the Compasses, and apply it transversely to the line of Chords, so that

the points of the Compasses may fall upon corresponding divisions, and they will shew the measure of the given Angle

USE OF THE LINES OF SINES, TANGENTS, AND SECANTS.

1. *Having the length of the Radius of a Circle, to find the length of the Chord, Sine, or Tangent of any Arch of that Circle.* Suppose the Chord, Sine, or Tangent of 30 degrees to a radius of 2 inches be required: open the Sector till the transverse distance of 60 and 60 on the lines of Chords is equal to 2 inches; then will the same extent reach from 45 to 45 on the lines of Tangents, and from 90 to 90 on the lines of Sines, so that to whatever radius the lines of Chords are set, to the same are all the others set. In this angular position of the legs, therefore, if the transverse distance between 30 and 30 be taken on the lines of Chords, Sines, or Tangents, with the Compasses, it will give the length of the Chord, Sine, or Tangent of 30 degrees, to the radius of 2 inches. When the required Chord is above 60°, or the Tangent above 45°, as suppose 70 degrees, proceed thus: for the Chord take the transverse distance of half the Arch, viz. 35 degrees, on the line of Sines, the double of which gives the length of the Chord of 70 degrees. To find the Tangent of 70 degrees to the same radius, make the transverse distance from 45 to 45, on the upper lines of Tangents, equal to 2 inches; then the extent between 70 and 70 on the same lines will be the length of the Tangent required.

2. *Having the radius of a Circle to find the Secant of any Arch of that Circle*: as again, suppose of 20 or 70 degrees, to a radius of 2 inches; make 2 inches the transverse distance between 0 and 0 on the lines of Secants; then will the transverse distance of 20 and 20, or 70 and 70, give the Secant of 20 or 70 degrees.

3. *The Radius of a Circle, and any line representing a Sine, Tangent, or Secant of an Arch of that Circle being given, to find the degrees and parts corresponding to that line.* Open the Sector to the given Radius, according as a Sine, Tangent, or Secant is concerned, then, taking the given line in the Compasses, apply the legs transversely till they fall on the corresponding divisions of the proper line, and these will point out the degrees and parts required.

In this manner the Angles of a right-angled Triangle may be estimated, by considering one Side as the radius of a Circle, and one of the other Sides as representing the Sine, Tangent, or Secant of the required Angle.

The Sectoral lines are likewise useful in working proportions in Trigonometry: Suppose, for example, the Hypothenuse of a Triangle measures 56, and the Angle opposite the perpendicular 32 degrees; to find the perpendicular the proportion will be, as Radius, or Sine of 90°, is to the Hypothenuse 56, so is Sine of the

Angle opposite the Perpendicular 32°, to the Perpendicular; therefore make the transverse distance of 90 and 90 on the lines of Sines equal to the lateral distance 56 on the lines of Lines; then the transverse distance of 32° on the line of Sines, applied as a lateral distance to the lines of Lines, will give 29.5 for the length of the perpendicular required.

PLANE TRIGONOMETRY.

PLANE TRIGONOMETRY is that branch of Geometry which teaches to compute the Sides and Angles of plane Triangles; it is divided into Right-Angled and Oblique-Angled Trigonometry according as it is applied to the mensuration of Right or Oblique-Angled Triangles.

RIGHT-ANGLED TRIGONOMETRY.

DEFINITIONS AND PRINCIPLES.

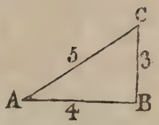
1. Every Triangle consists of six parts; namely, three Sides and three Angles.

2. The Sum of the three Angles of every plane Triangle is equal to two right Angles, or 180 degrees; hence, if one of the Angles be known, the sum of the other two may be found by subtracting the given angle from 180 degrees: also, if two of the Angles be known, their sum, subtracted from 180 degrees, will give the third Angle: again, in a Right-Angled Triangle (the Right Angle containing 90 degrees), the sum of the two Acute Angles is equal to 90 degrees; therefore, if one of the Acute Angles be given, the other will be found by subtracting the given Angle from 90 degrees.

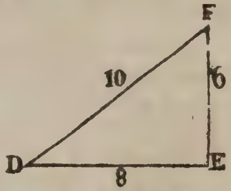
3. Any two Sides of a Triangle added together are greater than the third Side.

4. The greatest Side of a Triangle is opposite the greatest Angle, and the least Side opposite the least Angle; also, in the same Triangle, equal Sides are opposite to equal Angles.

5. Two Triangles are said to be similar when all the Angles of the one are respectively equal to all the Angles of the other; as for instance, the Triangle ABC is similar to the Triangle DEF because the Angles A, B, and C, are respectively equal to the Angles. D, E, and F.



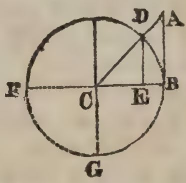
6. The Sides of similar Triangles, opposite to equal Angles, are proportional; thus in the Triangles ABC, and DEF, as AB is to DE, so is AC to DF, and so is CB to EF. Or as 4 : 8 : : 5 : 10 : : 3 : 6.

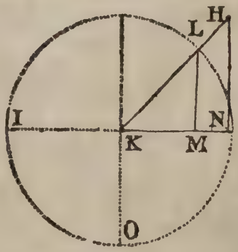


7. Similar arches of unequal Circles are such as contain the same number of degrees, &c. of their respective Circles.

8. The Sines, Tangents, and Secants of similar Arches are proportional to the radii of the Circles; thus, supposing the Arch DB, of the Circle DBGF to be similar to the Arch LN, of the Circle LNOI, then DE is to LM, AB to HN, and CA to KH, as CB or CD, is to KN or KL; that is, the Sine, Tangent, and Secant of one Arch is to the Sine, Tangent, and Secant of the other, as the radius of one Circle is to the radius of the other.

Hence, if the radius of a Circle be divided into a certain number of equal parts, and the length of the Sine, Tangent, or Secant of any Angle in such parts be given, the length of the Sine, Tangent, or Secant of the same Angle to any other radius may be found.





9. The lengths of the Sine, Tangent, and Secant for every degree and minute of the Quadrant, whose radius is 1, being calculated and arranged in a Table is called a TRIGONOMETRICAL CANON: and the logarithms, of these lengths are called logarithmic or artificial Sines, Tangents, and Secants; as in Table XXV. of this Work.

From these principles are deduced the following

RULES

RULES

For computing the Sides and Angles of Right-Angled Triangles.

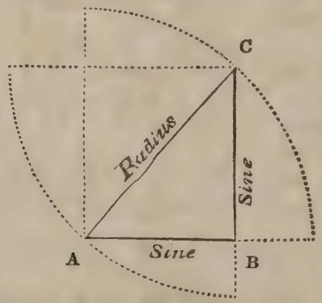
In every Right-Angled Triangle there must be two parts given, besides the right Angle, to find the other three; and one of these parts at least must be a Side, because the Angles will only give the proportion not the absolute length of the Sides.

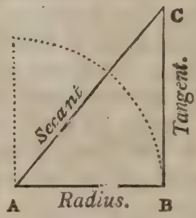
In every Right-Angled Triangle one of the Sides must be considered as representing the radius of a Circle; then,

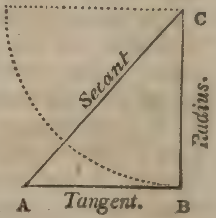
1, If the *Hypothenuse* be made radius, the Perpendicular and Base will each be the Sine of its opposite Angle.

2. If the *Base* be made radius, the Perpendicular will be the Tangent of its opposite Angle, and the Hypothenuse the Secant of the same Angle.

3. If the *Perpendicular* be made radius, the Base will be the Tangent of its opposite Angle, and the Hypothenuse the Secant of the same Angle. The Sine, Tangent, or Secant of one Angle being, in each case, the Co. Sine, Co. Tangent, or Co. Secant of the other.







Thus, if in the Triangles ABC the Hypothenuse AC be considered as radius of a Circle, then it is evident the Perpendicular BC will be the Sine of the Angle A, and the Base AB the Sine of the Angle C; if the Base AB be made radius, then the Perpendicular BC will be the Tangent of the Angle A, and the Hypothenuse AC the Secant of Angle A; if the Perpendicular BC be made radius, then the Base AB will be the Tangent of the Angle C, and the Hypothenuse the Secant of Angle C.

Since the Acute Angles A and C contain together 90 degrees, they are the complements of each other; therefore the Sine, Tangent, and Secant of Angle A is the Co. Sine, Co. Tangent, and Co. Secant of Angle C; and the Sine, &c. of Angle C is the Co. Sine, &c. of Angle A. (See Definition XXXIV. Geom.)

To find a Side.

Consider any one of the Sides as representing the radius of a Circle, and write upon it the word *radius*; then, upon the other Sides write the parts they represent according to the preceding rules, which call the *names* of the Sides; then say,

As the name of the given Side
Is to the given Side,
So is the name of the Side required
To the Side required.

To find an Angle.

Consider one of the given Sides as representing the radius of a Circle, and write upon it the word *radius*; and upon the other Sides write the parts they represent according to the preceding rules; then say,

As the Side representing Radius
Is to Radius,
So is the other given Side
To the Sine, Tangent, or Secant of the Angle by it represented.

Having raised the Canons, or Proportions, they may be worked by the common Rule of Three, taking the lengths of the Sines, Tangents, or Secants, of the Angles, to Radius 1, from the proper Table; but as Logarithms considerably abbreviate the calculation by performing Multiplication by Addition, and Division by Subtraction, it is more usual to take out the logarithms of the three given terms; (the Logarithm of Radius being 10.00000,) then, adding the Logarithms of the second and third terms together, and from their sum subtracting the Logarithm of the first term, the remainder will be the Logarithm of the fourth term, which being found in the proper Table, the number, or the degrees and minutes corresponding to it, will give the required Side or Angle.

Note. The Logarithms for Sides are to be taken from Table XXIV., and for the Sines, Tangents, or Secants of Angles, from Table XXV.

We shall now proceed to exemplify the above Rules by the following Cases, which we shall resolve by four different methods: viz. By Geometrical Construction; by Logarithmic Calculation, and by the Common and Sliding Gunters.

CASE I.

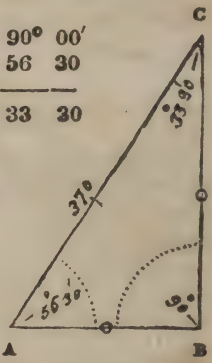
The Angles and the Hypothenuse given to find the Base and the Perpendicular.

Example. Given the Hypothenuse AC, 370 miles, (or any other measure of length,) the Angle A 56° 30′, and consequently the Angle C 33° 30′; required the Base AB and Perpendicular BC.

BY CONSTRUCTION.

Draw the line AB, of any length and make the Angle at A, 56° 30′ (Prob. XII. Geometry;) from A to C lay off 370, the length of the Hypothenuse, taken from any convenient Scale of equal parts, and from the point C let fall the perpendicular CB, (Prob. III. Geom.;) then ABC is the Triangle required: the Base AB, measured on the same scale of equal parts by which the Hypothenuse was measured, will be 204.2, and the Perpendicular BC 308.5.

	90°	00′
Angle A	56	30
Angle C	33	30



BY CALCULATION.

Making the Hypothenuse Radius, AB will be the Sine of Angle C, and CB the Sine of Angle A; then

To find the Base AB.		To find the Perpendicular BC.	
As Radius .	10.00000	As Radius .	10.00000
Is to Hypoth. AC 370	2.56820	Is to Hypoth. AC 370	2.56820
So is Sine Ang. C 33° 30′	9.74189	So is Sine Ang. A 56° 30′	9.92111
	12.31009		12.48931
	10.00000		10.00000
To the Base AB 204.2	2.31009	To the Perpend. BC 308.5	2.48931

Making the Base Radius, BC will be the Tangent, and AC the Secant of Angle A; then,

To find the Base.		To find the Perpendicular	
As Sec. of Ang. A 56° 30′	10.25811	As Sec. of Ang. A. 56° 30′	10.25811
Is to Hypoth. AC 370	2.56820	Is to Hypoth. AC 370	2.56820
So is Radius .	10.00000	So is Tan. of Ang. A 56° 30′	10.17922
	12.56820		12.74742
	10.25811		10.25811
To the Base AB 204.2	2.31009	To the Perpend. BC 308.5	2.48931

Making the Perpendicular Radius, AB will be Tangent, and AC Secant, of Angle C; then,

To find the Base.		To find the Perpendicular.	
As Sec. of Ang. C 33° 30′	10.07889	As Sec. of Ang. C 33° 30′	10.07889
Is to Hypoth. AC 370	2.56820	Is to Hypoth. AC 370	2.56820
So is Tan. Ang. C 33° 30′	9.82078	So is Radius .	10.00000
	12.38898		12.56820
	10.07889		10.07889
To the Base AB 204.2	2.31009	To the Perpend. BC 308.5	2.48931

BY THE COMMON GUNTER*.

1st. Extend the Compasses from Radius†, or 90°, to Angle C 33° 30′ on the line of Sines, and that extent will reach from the Hypothenuse 370 to 204.2, the measure of the Base, on the line of Numbers.

2dly. Extend the Compasses from Radius, or 90°, to Angle A 56° 30′ on the line of Sines, and that extent will reach from the Hypothenuse 370 to 308.5, the measure of the Perpendicular, on the line of Numbers.

BY THE SLIDING GUNTER.

1st. Set radius, or 90°, on the sliding line of Sines, to Angle C 33° 30′ on the fixed line of Sines; then, opposite to the Hypothenuse 370 on the sliding line of Numbers, will be the Base 204.2 on the fixed line of Numbers.

2dly. Set 90° on the sliding line of Sines, to Angle A 56° 30′ on the fixed line of Sines: then, opposite to the Hypothenuse 370 on the sliding line of Numbers, will be the Perpendicular 308.5 on the fixed line of Numbers.

CASE II.

The Angles and one of the Legs given, to find the Hypothenuse and the other Leg.

Example. Given the Base AB 625, and the Angle A 48° 45′, to find the Hypothenuse AC, and the Perpendicular BC.

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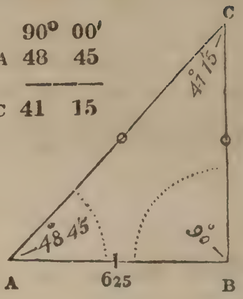
* In working the several Cases by Gunter's Scales, we shall always suppose the Hypothenuse Radius, where it can be done, being the most simple of the three.

† Radius, on Gunter's Scale, is either 8 points on the line of Sine Rhumbs, 4 points on the line of Tangent Rhumbs, 90 degrees on the line of Sines, or 45 degrees on the line of Tangents.

BY CONSTRUCTION.

Draw the Base AB, which make equal to 625, taken from a scale of equal parts; and upon B erect the Perpendicular BC, (Prob. II. or XII. Geom.;) make the Angle A equal to 48° 45′, (Prob. XII. Geom.,) and draw the Hypothenuse AC to cut the Perpendicular BC in the point C; then AC, measured on the same scale of equal parts that AB was, will be 947.9, and BC, 712.7.

	90°	00′
Ang. A	48	45
Ang. C	41	15



BY CALCULATION.

Making the Hypothenuse Radius, AB will be the Sine of Angle C, and CB the Sine of Angle A; then,

To find the Hypothenuse.		To find the Perpendicular.	
As Sine of Ang. C 41° 15′	9.81911	As Sine of Ang. C 41° 15′	9.81911
Is to the Base AB 625	2.79588	Is to the Base AB 625	2.79588
So is Radius .	10.00000	So is Sine of Ang. A 48° 45′	9.87612
	12.79588		12.67200
	9.81911		9.81911
To the Hypoth. AC 947.9	2.97677	To the Perpend. BC 712.7	2.85289

Making the Base Radius, BC will be the Tangent, and AC the Secant, of Angle A; then,

To find the Hypothenuse.		To find the Perpendicular.	
As Radius .	10.00000	As Radius .	10.00000
Is to the Base AB 625	2.79588	Is to the Base AB 625	2.79588
So is Sec of Ang. A 48° 45′	10.18089	So is Tan. of Ang. A 48° 45′	10.05701
	12.97677		12.85289
	10.00000		10.00000
To the Hypoth. AC 947.9	2.97677	To the Perpend. BC 712.7	2·85289

Making the Perpendicular Radius, AB will be Tangent, and AC Secant, of Angle C; then,

To find the Hypothenuse.		To find the Perpendicular.	
As Tang. of Ang. C 41° 15′	9 94299	As Tang of Ang. C 41° 15′	9.94299
Is to the Base AB 625	2.79588	Is to the Base AB 625	2.79588
So is Sec. of Ang. C 41° 15′	10.12387	So is Radius .	10.00000
	12.91975		12.79588
	9.94299		9.94299
To the Hypoth. AC 947.9	2.97676	To the Perpend. BC 712.7	2.85289

BY THE COMMON GUNTER.

1st. Extend the Compasses from Angle C 41° 15′ to Radius, or 90°, on the line of Sines, and that extent will reach from the Base 625 to the Hypothenuse 947.9 on the line of Numbers.

2dly. Extend the Compasses from Angle C 41° 15′ to Angle A 48° 45′ on the line of Sines, and that extent will reach from the Base 625 to the Perpendicular 712.7 on the line of Numbers.

BY THE SLIDING GUNTER.

1st. Set Angle C 41° 15′ on the sliding line of Sines, to Radius, or 90° on the fixed line of Sines; then, opposite to the Base 625 on the sliding line of Numbers, will be the Hypothenuse 947.9 on the fixed line of Numbers.

2dly. Set Angle C 41° 15′ on the sliding line of Sines, to Angle A 48° 45′ on the fixed line of Sines; then, opposite to the Base 625 on the sliding line of Numbers, will be the Perpendicular 712.7 on the fixed line of Numbers.

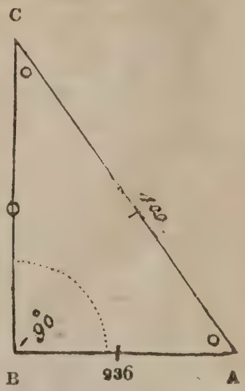
CASE III.

The Hypothenuse and one Leg given to find the Angles and the other Leg.

Example. Given the Hypothenuse AC 400 and the Base BA 236; required the Angles A and C, and the Perpendicular BC.

BY CONSTRUCTION.

Draw the Base BA, which make equal to 236; upon B erect the Perpendicular BC, (Prob. II. or XII. Geom.) and taking the distance 400 in the Compasses, place one foot in A, and let the other foot cross BC in C, and draw the line AC; then will the Perpendicular BC measure 323, the Angle C 36° 9′ and the Angle A 53° 51′. (Prob. XIII. Geom.)



BY CALCULATION.

Making the Hypothenuse Radius, BA will be the Sine of Angle C, and BC the Sine of Angle A; then,

To find the Angles.		To find the Perpendicular.	
As the Hypoth. AC 400	2.60206	As Radius .	10.00000
Is to Radius .	10.00000	Is to the Hypoth. AC 400	2.60206
So is the Base BA 236	2.37291	So is Sine Ang. A 53° 51′	9.90713
	12.37291		12.50919
	2.60206		10.00000
To Sine of Ang. C 36° 9′	9.77085	To the Perpend. BC 323	2.50919
90 0			
Angle A 53 51			

Making the Base Radius, BC will be the Tangent, and AC the Secant, of Angle A; then,

To find the Angles.		To find the Perpendicular.	
As the Base BA 236	2.37291	As Radius .	10.00000
Is to Radius .	10.00000	Is to the Base BA 236	2.37291
So is the Hypoth. 400	2.60206	So is Tan. Ang. A 53° 51′	10.13635
	12.60206		12.50926
	2.37291		10.00000
To Sec. of Ang. A 53° 51′	10.22915	To the Perpend. BC 323	2.50926
90 00			
Angle C 36 9			

BY THE COMMON GUNTER.

1st. Extend from the Hypothenuse 400 to the Base 236 on the line of Numbers, and that extent will reach from radius 90° to Angle C 36° 9′ on the line of Sines; hence the Angle A will be 53° 51′

2dly. Extend from Radius 90° to Angle A 53° 51′ on the line of Sines, and that extent will reach from the Hypothenuse 400 to the Perpendicular 323 on the line of Numbers.

BY THE SLIDING GUNTER.

1st. Set the Hypothenuse 400 on the sliding line of Numbers to the Base 236 on the fixed line of Numbers; then, opposite to radius or 90°, on the sliding line of Sines, will be Angle C 36° 9′ on the fixed line of Sines; hence the Angle A will be 53° 51′.

2dly. Set radius, or 90°, on the sliding line of Sines, to Angle A 53^6 51′ on the fixed lines of Sines; then, opposite to the

Hypothenuse 400 on the sliding line of Numbers, will be the Perpendicular 323 on the fixed line of Numbers.

Note. The Perpendicular may be found independent of the Angles; thus: subtract the square of the Base from the square of the Hypothenuse, the square root of the remainder will be the length of the Perpendicular required.

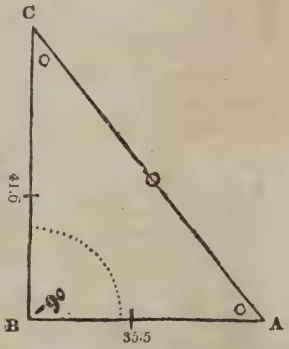
CASE IV.

The Base and Perpendicular given, to find the Angles and the Hypothenuse.

Example. Given the Base BA 35.5, and the Perpendicular BC 41.6; required the Angles A and C, and the Hypothenuse AC.

BY CONSTRUCTION.

Draw the line BA, and upon B raise the Perpendicular BC, (Prob. II. or XII. Geom.); make BA equal to 35.5 and BC equal to 41.6, and draw the line AC; then the Hypothenuse AC will measure 54.7, the Angle A 49° 31′, and the Angle C 40° 29′, (Prob. XIII. Geom.)



BY CALCULATION.

Making the Base Radius, BC will be the Tangent, and AC the Secant of Angle A.

To find the Angles.

As the Base BA 35.5	1.55023
Is to Radius .	10.00000
So is the Perpend. BC 41.6	1.61909
	11.61909
	1.55023
To Tan. of Ang. A 49° 31′	10.06886
90 00	
Ang. C. 40 29	

To find the Hypothenuse.

As Radius .	10.00000
Is to the Base BA 35.5	1.55023
So is Sec. of Ang. A 49°31′	10.18760
	11.73783
	10.00000
To the Hypoth. AC 54.68	1.73783

Making the Perpendicular Radius, BA will be the Tangent, and AC the Secant, of Angle C.

To find the Angles.		To find the Hypothenuse.	
As the Perpend. BC 41.6	1.61909	As Radius .	10.00000
Is to Radius .	10.00000	Is to Perpend. BC 41.6	1.61909
So is the Base BA 35.5	1.55023	So is Sec. of Ang. C 40° 29′	10.11885
	11.55023		11.73794
	1.61909		10.00000
To Tang. of Ang. C 40° 29′	9.93114	To the Hypoth. AC 54.69	1.73794
90 00			
Angle A 49 31			

BY THE COMMON GUNTER.

1st. Extend the Compasses from the Base 35.5 to the Perpendicular 41.6 on the line of Numbers, and that extent will reach from Radius 45° to Angle A 49° 31′ on the line of Tangents*: hence Angle C will be 40° 29′.

2dly. Extend the Compasses from Angle C 40° 29′ to Radius 90° on the line of Sines, and that extent will reach from the Base 35.5 to the Hypothenuse 54.68 on the line of Numbers.

BY THE SLIDING GUNTER.

1st. Set the Base 35.5 on the sliding line of Numbers to the Perpendicular 41.6 on the fixed line of Numbers; then, opposite to Radius, or 45° on the sliding line of Tangents, will be Angle A 49° 31′ on the fixed line of Tangents*; hence Angle C will be 40° 29′.

2dly. Set Angle C 40° 29′ on the sliding line of Sines, to Radius, or 90°, on the fixed line of Sines; then, opposite to the Base 35.5 on the sliding line of Numbers, will be the Hypothenuse 54.68 on the fixed line of Numbers.

NOTE. The Hypothenuse may be found, independent of the Angles; thus: add together the squares of the Perpendicular and Base; and the square root of the sum will be the Hypothenuse required.

QUESTIONS FOR EXERCISE.

1. Given the Hypothenuse 108 and the Angle opposite the Perpendicular 25° 36′; required the Base and Perpendicular.

Ansr. The Base is 97.4, and the Perpendicular 46.66.

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* The same point represents both 49° 31 and 40° 29′, but as the third term is more than the first, the Angle A, or fourth term, will consequently be more than 45°, which is Radius, or the second term on the line of Tangents.

2. Given the Base 96 and its opposite Angle 71° 45′; required the Perpendicular and the Hypothenuse.

Ansʳ. The Perpendicular is 31.66 and the Hypothenuse 101.1.

3. Given the Perpendicular 360 and its opposite Angle 58° 20′; required the Base and the Hypothenuse.

Ansʳ. The Base is 222 and the Hypothenuse 423.

4. Given the Base 720 and the Hypothenuse 980; required the Angles and the Perpendicular.

Ansʳ. The Angles are 47°17′ and 42° 43′, and the Perpendicular 664.8.

5. Given the Perpendicular 110.3 and the Hypothenuse 176.5; required the Angles and the Base.

Ansʳ. The Angles are 38° 41′ and 51°19′, and the Base 137.8

6. Given the Base 360 and the Perpendicular 480; required the Angles and the Hypothenuse.

Ansʳ. The Angles are 53° 8′ and 36° 52′, and the Hypothenuse 600.

OBLIQUE ANGLED TRIGONOMETRY.

RULES

For computing the Sides and Angles of Oblique-Angled Triangles.

I. When two of the three given parts are a Side, and its opposite Angle.

To find a Side.

As the Sine of any given Angle
Is to its opposite Side,
So is the Sine of any other given Angle
To its opposite Side.

To find an Angle.

As any given Side
Is to the Sine of its opposite Angle,
So is any other given Side
To the Sine of its opposite Angle.

When the given Side, opposite the given Angle, is greater than the other given Side, then the Angle opposite that other given Side is always acute; but when the given Side, opposite the given Angle, is less than the other given Side, then the Angle opposite that other given Side may be either acute or obtuse, which consequently must be determined from the nature of the Triangle.

II. When two Sides and the Angle contained between them are given.

As the Sum of the two given Sides,
Is to their difference,
So is the Tangent of half the Sum of the unknown Angles,
To the Tangent of half their difference:

This half difference added to half the Sum of the unknown Angles, gives the greater Angle, and subtracted, leaves the less Angle. The Angles being thus all known, the remaining Side is to be found by Rule I.

III. When the three Sides are given, to find the Angles.

As the Base, or greatest Side,
Is to the Sum of the other two Sides,
So is the difference of those Sides,
To the difference of the Segments made by a Perpendicular let fall from the greatest Angle upon the Base.

Then half this difference added to half the sum of the Segments; that is, half the Base, gives the greater Segment, and subtracted gives the less Segment. Hence the Triangle will be divided into two Right-Angled Triangles, in each of which there will be given the Hypothenuse and the Base to find the other Angles, which may be done by Rule 1st, or by those in Right-Angled Trigonometry.

CASE I.

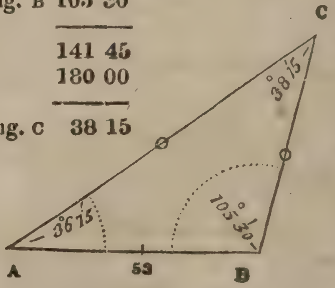
The Angles and one Side given to find the other Sides.

Example. Given the Angle A 36° 15′, the Angle B 105° 30′, and the Side AB 53: required the Sides AC and BC.

BY CONSTRUCTION.

Ang. A 36° 15′
Ang. B 105 30
141 45
180 00
Ang. C 38 15

Draw the line AB and make it equal to 53; make the Angle BAC 36° 15′ and the Angle ABC 105° 30′, (Prob. XII. Geom.,) and draw the lines AC and BC till they meet in C; then AC will measure 82.5, and BC 50.62.



BY CALCULATION.

To find the Side AC by Rule I.	
As Sine of Ang. C 38° 15′	9.79176
Is to the Side AB 53	1.72428
So is Si. of Ang. B* 105° 30′	9.98391
	11.70819
	9.79176
To the Side AC 82.5	1.91643

To find the Side BC by Rule I.	
As Sine of Ang. C 38° 15′	9.79176
Is to the Side AB 53	1.72428
So is Sine of Ang. A 36° 15′	9.77181
	11.49609
	9.79176
To the Side BC 50.62	1.70433

BY THE COMMON GUNTER.

1st. Extend the Compasses from the Angle C 38° 15′ to 74° 30′, the supplement of Angle B, on the line of Sines, and that extent will reach from the Side AB 53 to the Side AC 82.5 on the line of Numbers.

2d. Extend the Compasses from the Angle C 38° 15′ to the Angle A 36° 15′ on the line of Sines, and that extent will reach from the Side AB 53 to the Side BC 50.6 on the line of Numbers.

BY THE SLIDING GUNTER.

1st. Set Angle C 38° 15′ on the sliding line of Sines to supplement of Angle B 74° 30′ on the fixed line of Sines; then, opposite to the Side AB 53 on the sliding line of Numbers will be the Side AC 82.5 on the fixed line of Numbers.

2d. Set Angle C 38° 15′ on the sliding line of Sines, to Angle A 36° 15′ on the fixed line of Sines; then, opposite to the Side AB 53 on the sliding line of Numbers will be the Side BC 50.6 on the fixed line of Numbers.

CASE II.

Two Sides and an Angle opposite one of them given, to find the other Angles and the third Side.

Example. Given the Side AB 336, the Side BC 355, and the Angle A 49° 26′; required the Angles B and C, and the Side AC.

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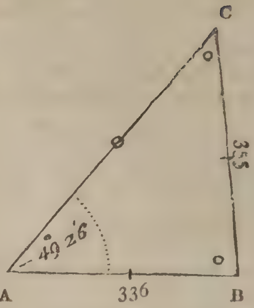
* For the manner of finding the Log. Sine of 105° 30′ see explanation of Table XXV.

BY CONSTRUCTION.



Draw the line AB, which make equal to 336; draw the line AC so as to make an Angle of 49° 26′ with AB (Prob. XII. Geom.;) take the length of BC in the Compasses, and, setting one foot in B; let the other cut the line AC in C, and draw the line BC; then the Angle B will measure 84° 36′, the Angle C 45° 58′, (Prob. XIII. Geom.,) and the Side AC 465.3.

BY CALCULATION.

To find the Angle C by Rule I.	
As the Side BC 355	2.55023
Is to Sine of Ang. A 49° 26′	9.88061
So is the Side AB 336	2.52634
	12.40695
	2.55023
To Sine of Ang. C 45° 58′	9.85672

Ang. A	49 26
Sum	95 24
	180 00
Angle B	84 36

To find the Side AC by Rule I.	
As Sine of Ang. A 49° 26′	9.88061
Is to the Side BC 355	2.55023
So is Sine of Ang. B 84° 36′	9.99807
	12.54830
	9.88061
To the Side AC 465.3	2.66769

BY THE COMMON GUNTER.

1st. Extend the Compasses from the Side BC 355 to the Side AB 336 on the line of Numbers, and that extent will reach from Angle A 49° 26′ to Angle C 45° 58′ on the line of Sines; hence the Angle B is 84° 36′.

2d. Extend the Compasses from the Angle A 49° 26′ to the Angle B 84° 36′ on the line of Sines; and that extent will reach from the Side BC 355 to the Side AC 465.3 on the line of Numbers.

BY THE SLIDING GUNTER.

1st. Set the Side BC 355 on the sliding line of Numbers to the Side AB 336 on the fixed line of Numbers; then, opposite to Angle A 49° 26′ on the sliding line of Sines will be Angle C 45° 58′ on the fixed line of Sines; hence the Angle B is 84° 36′.

2d. Set Angle A 49° 26′ on the sliding line of Sines to Angle B 84° 36′ on the fixed line of Sines; then, opposite the Side BC 355 on the sliding line of Numbers will be the Side AC 465.3 on the fixed line of Numbers.

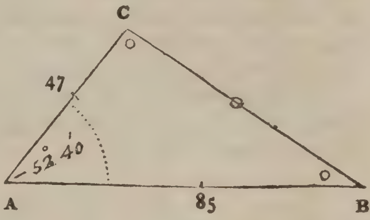
CASE III.

Two Sides and their contained Angle given, to find the other Angles and the third Side.

EXAMPLE. Given the Side AB 85, the Side AC 47, and the Angle A 52° 40′: required the Angles C and B, and the Side BC.

BY CONSTRUCTION.

Draw the line AB and make it equal to 85; at A make the Angle BAC 52° 40′ (Prob. XII. Geom.;) from A to C lay off 47, and draw the line BC; then ABC is the Triangle required; the Angle B will measure 33° 29′, the Angle C 93° 51′ (Prob. XIII. Geom.,) and the Side BC 67.7.



BY CALCULATION.

To find the Angles by Rule II.

Side AB	85		As the Sum of the Sides AB, AC,	132	2.12057
Side AC	47		Is to their difference .	38	1.57978
Sum .	132		So is Tang. of half the Sum of Angles B and C	63° 40′	10.30543
Diff. .	38				11.88521
					2.12057
		180° 00′			
Angle A .		52 40	To Tang. of half their diff.	30° 11′	9.76464
Sum of Ang. B & C		127 20	Sum gives the great^{r} Ang. C	93 51	
Half Sum		63 40	Diff. gives the less Ang. B	33 29	

To find the Side BC by Rule I.

As Sine of Angle B	33° 29′	9.74170
Is to the Side AC .	47	1.67210
So is Sine of Angle A	52° 40′	9.90043
		11.57253
		9.74170
To the Side BC 67.74		1.83083

NOTE. This Triangle may be solved by letting fall a Perpendicular from the Angle C on the Side AB, which will divide it into two Right-Angled Triangles; then with the Hypothenuse AC and Angle A find the Perpendicular and the Base, which Base subtracted from the Side AB, will leave the Base of the other Triangle; then, with the Perpendicular and Base find the Angle B, which added to Angle A and their Sum subtracted from 180°, will give the Angle C, and, with one of the Angles and its opposite Side find the Side BC.

BY THE COMMON GUNTER.

1st. Extend the Compasses from the sum of the two Sides 132 to their difference 38; that extent will reach from 45° to a division* (16° 4′) on the line of Tangents; then, the extent from this division to half the Sum of the unknown Angles 63° 40′ will reach from 45° to half their difference 30° 11′ on the line of Tangents, by which the Angles may be found as above.

2d. Extend from Angle B 33° 29′ to Angle A 52° 40′ on the line of Sines, that extent will reach from the Side AC 47 to the Side BC 67.7 on the line of Numbers.

BY THE SLIDING GUNTER.

1st. Set the Sum of the two Sides 132 on the sliding line of Numbers to their difference 38 on the fixed line of Numbers; then, opposite to 45°, on the sliding line of Tangents, will be a division* (16° 4′) on the fixed line of Tangents; then set half the Sum of the unknown Angles 63° 40′ on the sliding line of Tangents to this division (16° 4′) on the fixed line of Tangents: and opposite to 45° on the sliding line of Tangents, will be half their difference 30° 11′, on the fixed line of Tangents, by which the Angles are to be found as above.

2d. Set Angle B 33° 29′ on the sliding line of Sines, to Angle A 52° 40′ on the fixed line of Sines; then, opposite to the Side AC 47 on the sliding line of Numbers, will be the Side BC 67.7 on the fixed line of Numbers.

CASE IV.

The three Sides given to find the Angles.

Example. Given the Side AB 157, the Side BC 110, and the Side AC 88, to find the Angles A, B, and C.

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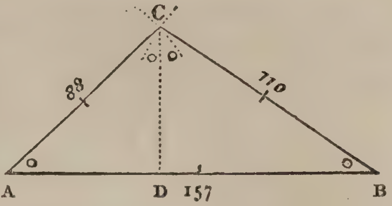
* The necessity of noting this division arises from the line of Tangents being read off from right to left above 45° instead of being reckoned on towards the right; hence, in this case the point of the Compasses falling without the Rule, the distance between this division and 63° 40′ gives the extent above 45°, which being applied to 45° backwards, falls upon the same division it would if the line were continued to the right: for the same reason it is necessary to note the division on the sliding Gunter

BY CONSTRUCTION.



Draw tne line AB, which make equal to 157; take the length of AC 88 in the Compasses, and with one foot on A describe the Arch C; then, with the length of CB 110 in the Compasses, and one foot in AB, describe an Arch cutting the former in C, to which draw the lines AC and BC; then ABC is the Triangle required; the Angle A will measure 42° 44′, the Angle B 32° 53′, and the Angle C 104° 23′, (Prob. XIII. Geom.)

BY CALCULATION.

To find the Segments AD, DB, by Rule III.

Side AC	88	As the Base or greatest Side AB, 157	2.19590
Side BC	110	Is to the Sum of the Sides AC, BC, 198	2.29666
		So is the diff. of the Sides AC, BC, 22	1.34242
Sum .	198		
			3.63908
Difference	22		2.19590
		To the diff. of the Segments AD, DB 27.74	1.44318

Half the diff. of the Segments	13.87
Half their Sum, or the Base AB	78.5
Sum gives the great^r Segment DB	92.37
Diff. give the less Segment AD	64.63

To find the Angles by Rule I.

As the Side AC 88 .	1.94448	As the Side BC 110	2.04139
Is to Radius, or Sine 90°	10.00000	Is to Radius, or Sine 90°	10.00000
So is the Segment AD 64.63	1.81043	So is the Segment DB 92.37	1.96553
	11.81043		11.96558
	1.94448		2.04139
To Sine of Ang. ACD 47° 16′	9.86595	To Sine of Ang. BCD 57° 7′	9.92414
90 00		90 00	
Angle CAD 42 44		Ang. CBD 32 53	

Ang. ACD 47° 16′
Ang. BCD 57 7

Sum gives Ang. ACB 104 23

BY THE COMMON GUNTER.

1st. Extend the Compasses from the Base 157 to the Sum of the two Sides 198 on the line of Numbers; that extent will reach from the difference of the Sides 22, to the difference of the Segments 27.7; hence the Segments will be found as above.

2d. Extend the Compasses from the Side AC 88, to the lesser Segment AD 64.6 on the line of Numbers; that extent will reach from 90° to the Angle ACD 47° 16′ on the line of Sines; hence the Angle CAD is 42° 44′.

3d. Extend the Compasses from the Side CB 110 to the greater Segment 92.4; that extent will reach from 90° to the Angle DCB 57° 7′ on the line of Sines; hence the Angle CBD is 32° 53′.

BY THE SLIDING GUNTER.

1st. Set the Base 157 on the sliding line of Numbers to the Sum of the two Sides 198 on the fixed line of Numbers; then, opposite to the difference of the Sides 22 on the sliding line of Numbers will be the difference of their Segments 27.7 on the fixed line of Numbers, by which the Segments are found as above.

2d. Set the Side AC 88 on the sliding line of Numbers to the lesser Segment 64.6 on the fixed line of Numbers: then, opposite to 90° on the sliding line of Sines will be Angle ACD 47° 16′ on the fixed line of Sines; hence Angle CAD is 42° 44′.

3rd. Set the Side CB 110 on the sliding line of Numbers to the greater Segment 92.4 on the fixed line of Numbers; then, opposite to 90° on the sliding line of Sines will be the Angle DCB 57° 7′ on the fixed line of Sines: hence the Angle CBD is 32° 53′.

QUESTIONS FOR EXERCISE.

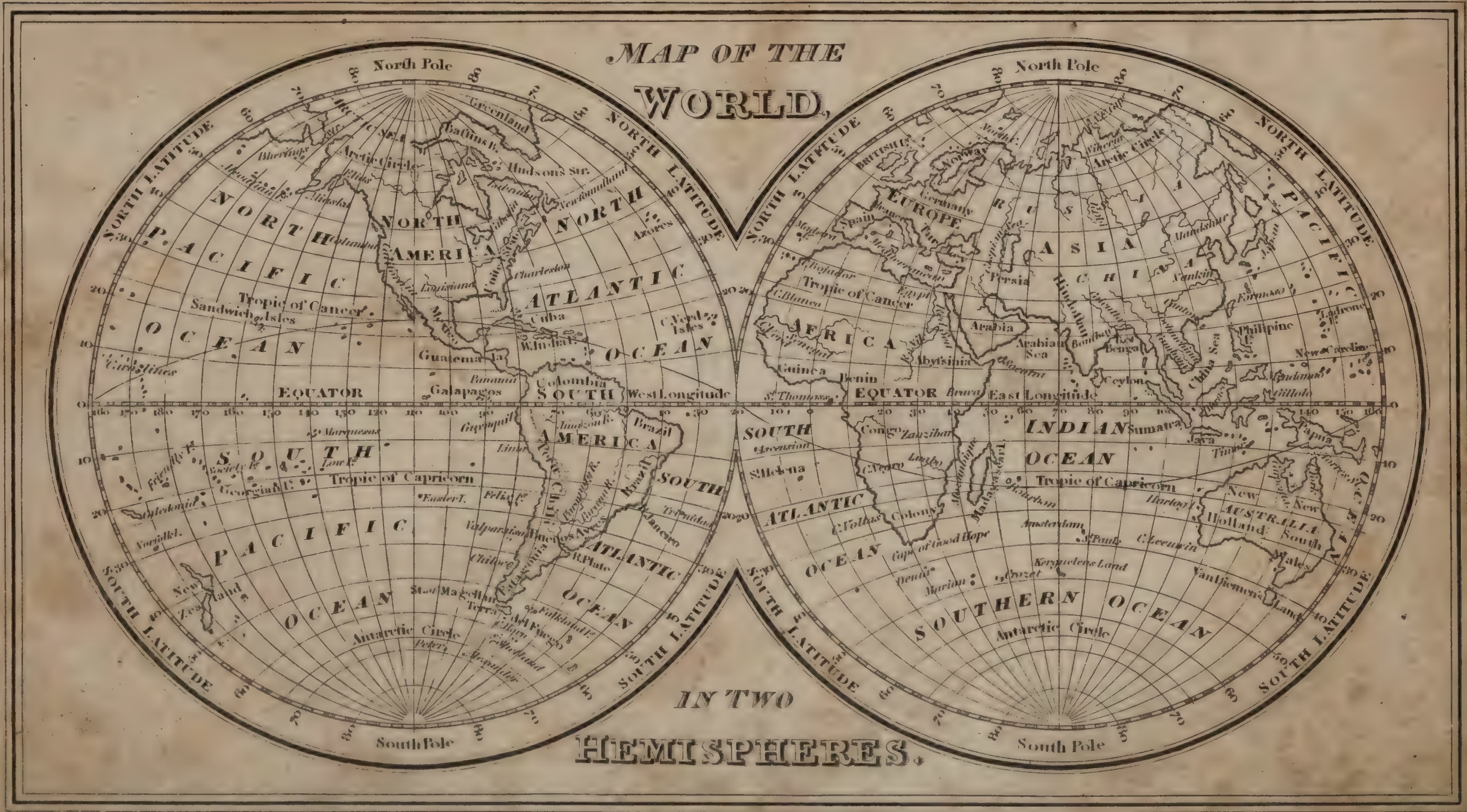
1. Given one Side 129, an adjacent Angle 56° 30′, and the opposite Angle 81° 36′: required the third Angle and the remaining Sides.

Ans^r. The third Angle is 41° 54′, and the remaining Sides are 108.7 and 87.08.

2. Given one Side 96.5, another Side 59.7, and the Angle opposite the latter Side 31° 30′: required the remaining Angles and the third Side.

Ans^r. This Question is ambiguous, the given Side opposite the given Angle being less than the other given Side (See Rule I.;) hence, if the Angle opposite the Side 96.5 be acute, it will be 57° 38′, the remaining Angle 90° 52′, and the third Side 114.2; but if the Angle opposite the Side 96.5 be obtuse, it will be 122° 22′, the remaining Angle 26° 8′, and the third Side 50.32

Plate II.



MAP OF THE WORLD, IN TWO HEMISPHERES.

J. Norie delin.t

Stephenson sc.

3. Given one Side 110, another Side 102, and the contained Angle 113° 36′: required the remaining Angles and the third Side.

Ansʳ. The remaining Angles are 34° 37′ and 31° 47′, and the third Side is 177.5.

4. Given the three Sides respectively, 120.6, 125.5, and 146.7: required the Angles.

Ansʳ. The Angles are 51° 53′, 54° 58′, and 73° 9′.

GEOGRAPHY.

GEOGRAPHY is the art of describing the figure, magnitude, and positions of the several parts of the surface of the Earth.

OF THE FIGURE AND MAGNITUDE OF THE EARTH.

Various opinions were entertained by the ancients respecting the figure of the Earth: some imagined it an immense plane surrounded by an impassable Ocean: others, that it was cylindrical; and some, that it was a Sphere or Globe; which last opinion is now ascertained to be nearly the truth. The most obvious of the several arguments which prove the Sphericity of the Earth, and what must particularly strike every Mariner, are, that when approaching the Shores of Countries, the points of high Rocks, Light-houses, Steeples of Churches, and other thin but lofty objects, come into view much sooner than houses or other buildings of greater magnitude but less height; in like manner when Ships are approaching each other at Sea, the Masts and Rigging are discerned some time before the Hull and lower parts of the Vessel, though much larger, come to view. Again, Seamen, it is well known, frequently discover distant lands from the tops of a Ship's Masts, long before they are visible to those who stand upon deck. These circumstances prove that the surface of the Earth is convex, and as the same appearances happen wherever the observer is situated, this convexity must be uniform; hence we conclude that the Earth is globular. The Sphericity of the Earth is likewise demonstrated by Navigators who have sailed quite round it by constantly going westward and arriving home from the eastward, which could not be effected were the Earth a plane: thus Ferdinand Magellan, setting out on the west side of Spain, continued shaping his course westward till he returned home on the south eastern side of Spain; and thus also have Drake, Dampier, Cook, and others, circumnavigated the earth; and when in addition to these facts it is recollected that all the Rules of Navigation are conformable to the opinion of the Earth being nearly globular, and that these Rules never lead the Mariner into material error, these well known circumstances, without adducing others, (though others equally or more forcible might be adduced,) must sufficiently establish the belief, in the mind of every impartial and competent judge, that the Earth deviates but very little in its form, from that of a Sphere.

Supposing the Earth to be in the exact form of a Sphere, any section of it made by a plane passing through its center would be a Circle, the circumference of which being conceived to be divided into 360 equal parts called degrees, and the length of one of these measured, the whole circumference, and thence the diameter of the Earth, may be easily determined. For this purpose several Mathematicians have undertaken the measurement of a degree on a Meridian, and from the mean result of their several admeasurements we may conclude that the circumference of the Earth is nearly 25000, and its diameter 7957¾, English miles; also that one degree contains about 69.44 English miles, and that a nautical or geographical mile is equal to 6110 feet.

On comparison of the several admeasurements of a degree on a meridian, it was found they varied in different parts of the Earth; this circumstance, together with others arising from the principle of gravity, led to the belief that its figure was not that of an exact Sphere; and in fact it has been proved that the Earth is flatted at the poles, similar to the figure of an Orange, or rather that its form is that of an oblate Spheroid, which is a solid generated by the rotation of a Semi-ellipsis about its shorter axis: it has likewise been established, that its polar and equatorial diameters are respectively 7940 and 7977 English miles, being nearly in the ratio of 214 to 215 but since its figure differs so little from that of a perfect Sphere, it is usual for the ease of calculation to consider it of that form, which approaches sufficiently near the truth for almost all practical purposes either in Navigation or Astronomy.

OF THE NATURAL DIVISIONS OF THE EARTH.

The constituent parts of the Earth are Land and Water; these naturally divide its surface into various portions, which have received the following particular terms according to their size, shape, and situation.

A Continent is a large track of land comprehending several Empires, Kingdoms, or Countries, not separated by any Sea or Ocean, as the Continents of Europe, Asia, Africa, and America.

An ISLAND is a portion of land entirely surrounded by Water; as Great Britain and Ireland.

A PENINSULA is a part of land nearly encompassed with Water, except where it is joined to a Continent by a narrow neck or point of land; as the Morea in the Mediterranean Sea.

An ISTHMUS is the narrow neck of Land joining a Peninsula to the adjacent Land, and forms a communication between them; as the Isthmus of Darien, which joins North and South America.

A PROMONTORY is a high part of land that projects into the Sea, and is often called a CAPE when the land is high; and when it has but little elevation, it is more usually distinguished by the name of a POINT or HEAD. Thus the Cape of Good Hope is a mountainous Promontory, and the Lizard, at the entrance to the English Channel, a Point or Head-land.

An OCEAN is a vast collection of Water, separating Continents from each other; as the Atlantic and Pacific Oceans.

A SEA is a smaller collection of Water, communicating with some adjacent Ocean, and confined by land within a narrower space; as the Mediterranean and Baltic Seas. This term is sometimes used in a general sense for the whole body of salt Water on the terraqueous Globe.

A GULF is a part of the Sea or Ocean nearly surrounded by land, except where it immediately communicates with the Sea; as the Gulf of Venice, in the Mediterranean; the Gulfs of Finland and Bothnia, in the Baltic Sea.

A BAY is such a gulf or inlet as does not run very deep into the land; as the Bay of Biscay, between the Shores of France and Spain, and the Bay of Bengal in the East Indies. Bays of a smaller description are frequently denominated CREEKS, HAVENS, or ROADS, though the last term is usually applied to places upon any Coast where there is anchorage, and a certain degree of protection and shelter from winds.

A STRAIT is a narrow passage by which there is a communication between a Gulf and the adjacent Sea, or which joins one part of a Sea or Ocean with another; as the Strait of Gibraltar, which joins the Mediterranean Sea to the Atlantic Ocean.

A LAKE is a collection of Water in an inland part, and, strictly considered, has no communication with the Sea; as the Lake of Geneva. But this is not always attended to, for many of the Loughs or Lakes in Ireland and Scotland, and those in North America, as Lake Superior, Ontario, &c. are an exception.

OF THE IMAGINARY DIVISIONS OF THE EARTH.

In order to point out the exact relative situation of places on the surface of the terraqueous Globe, Geographers are obliged to imagine certain points, lines, and circles belonging thereto, of which such as will more immediately enter under our consideration we shall here explain.

The AXIS is an imaginary line passing through the center of the Earth: the extremities of this line are called the POLES: that which is nearest to us is called the *North Pole*, and its opposite the *South Pole*. The Earth revolves round the Axis, from West to East, in 24 hours, which causes the vicissitude of day and night.

The EQUATOR is a great Circle on the Earth equally distant from the Poles; it divides the Earth into two equal parts called HEMISPHERES; that having the North Pole in its Center is called the *Northern Hemisphere*, and the other the *Southern Hemisphere*.

MERIDIANS are imaginary Circles on the Earth passing through both the Poles, crossing the Equator at right Angles, and dividing the Globe into two parts, called the *Eastern* and *Western Hemispheres*; or rather, the Meridian of a place is a Semicircle passing through the place and terminating at the Poles, the remaining half being called the *opposite Meridian*; hence every North and South Line is part of a Meridian.

It is usual for Geographers to fix upon a Meridian passing through some remarkable place, and to call it the *first Meridian*; thus, the British esteem that the first Meridian which passes through the Royal Observatory at Greenwich; so the French reckon for their first Meridian that which passes through the Royal Observatory at Paris; the Spaniards that which passes through Cadiz, and some Geographers the Meridian of Teneriffe: hence it appears the fixing of a first Meridian is entirely arbitrary, most nations considering that the first Meridian which passes through their Capital, or principal Observatory.

The HORIZON is that apparent Circle which limits or bounds the view of a Spectator on the Sea, or on an extended plane, the eye being always supposed in the center of the Horizon. This Circle is divided into 32 parts called points, for a description of which see Mariner's Compass.

The Earth is sometimes divided by certain Circles, parallel to the Equator, into portions called ZONES; these are distinguished into two frigid, two temperate, and one torrid, in allusion to the general state of the Air, with respect to heat and cold, which prevails in each of the situations.

The FRIGID ZONES are those regions about the Poles where the Sun at certain times of the Year does not rise or set for some Days; they extend round the Poles as far as 23° 28′: the imaginary Circle which bounds this limit in our northern hemisphere is called the *Arctic Polar Circle*, and that portion of the Globe included within it the *North Frigid Zone*. The Circle which is at the same distance from the South Pole, in the southern hemisphere, is called the *Antarctic Polar Circle*, and the space between it and the Pole is termed the *South Frigid Zone*.

The TEMPERATE ZONES are those portions of the Earth comprehended between the Polar Circles, and two parallel Circles that are 23° 28′ distant from the Equator; of these parallels, that in the northern hemisphere is called the *Tropic of Cancer*; and the other in the southern hemisphere, the *Tropic of Capricorn.*

The TORRID ZONE is the space included between the two Tropics, over every part of which the Sun is vertical at some time of the Year.

Besides these divisions into Zones, the Ancients divided the Earth into CLIMATES, which are spaces contained between two parallels, where the difference in the longest day in each parallel is half an hour as far as the Polar Circles, and beyond that where they differ by a month; they likewise distinguished the inhabitants by different names according to the diversity of shadows of upright bodies at noon, and their relative situation with regard to each other—but these vague expressions, intended to give some general idea of the situation of different Countries, have at length given way to the more precise terms of Latitude and Longitude.

OF LATITUDE AND LONGITUDE.

The LATITUDE of a place is its distance from the Equator, measured by an Arch of a Meridian contained between the Equator and the given place; it is called either North or South, according as the given place is situated in the Northern or Southern Hemisphere. Latitude is therefore reckoned from the Equator towards the Poles, and never exceeds 90 degrees, that being the distance of the Poles from the Equator. Hence a Ship in North Latitude sailing northerly; or in South Latitude sailing southerly, increases her Latitude; but in North Latitude sailing southerly, or in South Latitude sailing northerly, she decreases her Latitude.

The PARALLEL OF LATITUDE of any place is a Circle passing through that place parallel to the Equator.

The DIFFERENCE OF LATITUDE between any two places is an Arch of a Meridian, contained between the parallels of Latitude of those places.

The LONGITUDE of a place is an Arch of the Equator comprehended between the first Meridian and that Meridian which passes through the given place. It is usual to reckon Longitude from the first Meridian either East or West, according as the given place lies in the Eastern or Western Hemispheres, until it meets at the opposite Meridian: therefore the Longitude of a place cannot exceed 180 degrees, or a Semicircle. A Ship in East Longitude sailing easterly, or in West Longitude sailing westerly, increases her Longitude; but in East Longitude sailing westerly, or in West Longitude sailing easterly, she decreases her Longitude.

The DIFFERENCE OF LONGITUDE between two places is an Arch of the Equator intercepted between the Meridians of those places, and cannot exceed 180 degrees.

PROBLEM I.

To find the difference of Latitude between two Places.

Rule. When the Latitudes are both of the same name, that is, both North or both South, subtract the less from the greater, and the remainder will be the difference of Latitude; but when one is North and the other South, their Sum will be the difference of Latitude.

Example I. What is the difference of Latitude between the Lizard and Cape Finisterre?

Latitude of the Lizard	49°	58′ N.
Lat. of Cape Finisterre	42	56 N.
Diff. of Latitude .	7	2
	60	
In Miles ·	422	

Example II. A Ship from Latitude 3° 10′ S. arrives to Latitude 2° 26′ N.: required the difference of Latitude made good.

Latitude left	3°	10′ S.
Latitude in	2	26 N.
Diff. of Latitude	5	36
	60	
In Miles .	336	

PROBLEM II.

With the Latitude left and the difference of Latitude, to find the Latitude in.

Rule. When the Latitude left and difference of Latitude are of the same name, their sum gives the Latitude in; but when they are of contrary names, their difference is the Latitude in, of the same name with the greater.

Example I. A Ship from the W. end of the Island of Madeira, in Latitude 32° 54′ N., sails North 520 Miles*: what Latitude is she in?

Latitude of Madeira	32°	54′ N.
Diff. of Lat. 520 or	8	40 N.
Latitude in .	41	34 N.

Example II. A Ship three days ago was in Latitude 2° 48′ N., and has since then sailed South 426 Miles: required her present Latitude.

Latitude left .	2°	48′ N.
Diff. of Lat. 426 or	7	6 S.
Latitude in .	4	18 S.

PROBLEM III.

To find the difference of Longitude between two Places.

Rule. If the Longitudes of the given places are both East or both West, subtract the less from the greater; but if one be East and the other West, add them together, and the sum or remainder will be the difference of Longitude. When the sum of the two Longitudes exceed 180 degrees subtract it from 360 degrees, and the remainder will be the difference of Longitude.

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* When the difference of Latitude or Longitude is given in Miles it is to be divided by 60, to reduce it to degrees and minutes.

Example I. What is the difference of Longitude between the Lizard and St. Mary's, one of the Western Islands?

Long. of the Lizard	5°	11′	W.
Long. of St. Mary's	25	14	W.
Diff. of Longitude	20	3	
	60		
In Miles	1203		

Example II. A Ship sailing Westward from Rotterdam I. in the Pacific Ocean arrives to Long. 164° 47′ E.: required the diff. of Long. made good.

Long. of Rotterdam I.	174°	45′	W.
Long. of Ship .	164	47	E.
Sum .	339	32	
	360	0	
Diff. of Longitude	20	28	
	60		
In Miles .	1228		

PROBLEM IV.

With the Longitude left and difference of Longitude, to find the Longitude in.

Rule. If the Longitude left and difference of Longitude be of contrary names, subtract the less from the greater, and the remainder will be the Longitude in, of the same name with the greater; but if the Longitude left and difference of Longitude are of the same name, their sum will be the Longitude in, of the same name with the Longitude left; if this sum exceed 180° subtract it from 360°, and the remainder will be the Longitude in, of a contrary name to the Longitude left.

Example I. Suppose a Ship from St. Helena sails eastward till her difference of Longitude is 220 Miles: required her Longitude in.

Long. of St. Helena	5°	43′	W.
Diff. of Long. 220 or	3	40	E.
Longitude in	2	3	W.

Example II. If a Ship from Longitude 176° 49′ W. sail westward till her difference of Longitude is 10° 14′ W., what is her present Longitude?

Longitude left .	176°	49′	W.
Diff. of Longitude	10	14	W.
Sum	187	3	
	360	0	
Longitude in	172	57	E.

DESCRIPTION AND USE

OF THE

LOG, HALF-MINUTE GLASS, AND COMPASS.

THE instruments used for estimating a Ship's path or track at Sea, are the Log, Half-Minute Glass, and Compass.

OF THE LOG AND HALF-MINUTE GLASS.

The common Log is a flat piece of Wood in the form of a Quadrant, with a sufficient quantity of lead fixed to the circular edge to keep it steady, and in a perpendicular position on the surface of the Water; to this is fastened a line about 120 fathoms long, called the Log Line, which is divided into spaces called Knots, and wound on a reel, from which it runs off freely when used.

The Half-Minute Glass is of the same shape with an Hour Glass, and contains such a quantity of Sand as will run through the hole in its neck in half a minute of time.

The use of these Instruments is to ascertain the velocity of a Ship, or at what rate she sails, by an operation called *heaving the Log*, which is performed in the following manner: The Reel being held by one Man, and the Half-Minute Glass by another, the Officer of the Watch throws the Log over the Ship's Quarter on the Lee Side, which swimming perpendicularly, remains stationary; and when he observes the first mark is going over the Ship's side, which is usually a red rag at the distance of ten or twelve fathoms from the Log, (that quantity, called *stray line*, being allowed in order to carry the Log out of the eddy of the Ship's Wake,) he gives notice to the Man who holds the Glass to turn it; and as soon as the Sand in the Glass is run out, the line is immediately stopped; then, the number of knots and fathoms which had run off at the expiration of the Glass being considered as miles and parts, gives the distance the Ship has run the preceding hour, if the wind has been constant. But if the gale has not been the same during the whole hour, or time between heaving the Log, or if there has been more sail set, or handed, there must be an allowance made for it according to the discretion of the Artist. Sometimes, when the Ship is before the Wind, and a great Sea setting after her, it will bring home the Log; in such cases it is customary to allow one mile in ten, and less in proportion if the Sea be not so great; a proper allowance ought also to be made if there be a head Sea. In heaving the Log great care should be taken to veer out the line as fast as the Log takes it; for if the Log is left to turn the reel itself, it will come home and give an erroneous distance.

When the Ship is sailing several knots an hour, sometimes Quarter-Minute Glasses are used, in which case the knots and fathoms run off the reel are to be doubled to give the hourly rate.

In Ships of War and East-Indiamen, it is usual to heave the Log once every hour, but in Merchant Ships only once every two hours.

The length of the Log-line between each knot ought to be 51 feet nearly, that being the same part of a Nautical Mile that half a Minute is of an Hour*, viz. 120th part: but as the Log is apt to be drawn after the Vessel, and since it is safer to have the reckoning rather before than after the Ship, 50 feet has been thought sufficient space between the knots, each of which contains 10 fathoms of 5 feet: indeed it is usual to allow only 48 feet to a knot, that is, 8 fathoms of 6 feet each, and sometimes a less quantity; with which a Glass is used running 28 Seconds: but whatever may be the assigned length of the intervals between the knots, it is most convenient to divide them decimally, or into ten equal parts, by which the computation of the Ship's run will be rendered more easy and accurate.

But both the Log-line and Half-minute Glass are frequently affected by alterations in the heat or moisture of the weather; it therefore becomes necessary often to examine them, and if found erroneous, to correct the Ship's run. The length of line between the knots may be easily ascertained by measuring them with a Rule; and the Half-minute Glass may be examined either by a watch with a second hand, or if that be not at hand, by the following method: fasten a plummet to a line and hang this on a nail, observing that the distance between the nail and the middle of the plummet be 39¼ inches; then swing the plummet and notice how often it passes under the nail while the Glass is running out, and that will be the number of seconds measured by the Glass.

The following Rules for correcting the Ship's run on account of the errors in the Log-line or Half-minute Glass, are given on a supposition that the knot ought to measure 50 feet, and the Glass to run 30 seconds.

CASE I.

When the Log-line is truly divided and the Glass faulty.

Rule. Multiply the distance given by the Log, by 30; divide the product by the seconds run by the Glass, and the quotient will be the true distance.

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* The length of a nautical mile is about 6110 feet, (see page 56,) this divided by 120, gives 50 feet 11 inches for the length of a knot.

Example I. If a Ship sail 8 knots by the Log, while the Glass is running out, which when measured is found to run 34 seconds, what is her true rate of sailing?

Distance by Log 8 knots
30
34)240(7 knots
238
2

Example II. Suppose the distance sailed by the Log is 75 miles and the Glass runs out in 27 seconds, what is the true distance run?

Distance by Log 7 miles
30
27)2250(83.3 true distance sailed.
216
90
81
90
81
9, &c.

CASE II.

When the Glass is true and the Log-line faulty.

Rule Multiply the distance sailed by twice the measured length of a knot, then point off two figures to the right, and the remainder will be the true distance.

Example I. A Ship sails 9 knots in half a minute, by a Log measuring 52 feet; required her true rate of sailing?

Distance by Log	9 knots
Twice length of knot	104
True rate .	9.36 knots,

or 9 knots 4 fathoms nearly.

Example II. If a Ship sail 195 miles by a Log which measures 48 feet: what is her true distance run?

Distance by Log. .	195 miles
Twice length of knot	96
	1170
	1755
True distance .	187.20 miles

CASE III.

When the Glass and Log-line are both faulty.

Rule. Multiply the distance sailed by the Log, by six times the measured length of a knot, and divide the product by the seconds run by the Glass, the quotient, pointing off one figure to the right, will be the true distance.

Example I. If a Ship runs 5 knots of a Log-line of 45 feet to a knot, while a Glass of 25 seconds is running out, what is her true rate of sailing?

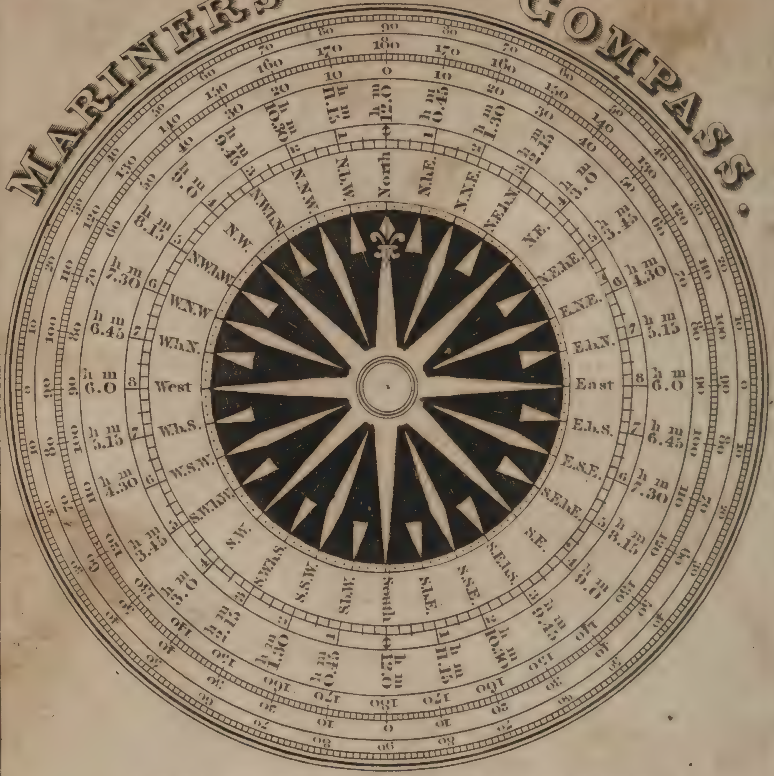
Distance run by Log	5
6 times length of knot	45×6=270
Seconds run by Glass	25)135.0
True rate of Sailing .	5.4

or 5 knots 4 fathoms.

Example II. Suppose the distance sailed by the Log is 150 miles, the measured length of a knot is 51 feet, and the Glass runs 28 seconds: required the true distance run.

Distance by Log	150 miles
6 times length of a knot	306
	28)4590.0
True distance run	163.9 miles

MARINER'S COMPASS.



A TABLE OF THE ANGLES

which every Point & Quarter Point of the Compass makes with the Meridian.

NORTH		POINTS	°	′	″	POINTS	SOUTH	
		0 - ¼	2	48	45	0 - ¼		
		0 - ½	5	37	30	0 - ½		
		0 - ¾	8	26	15	0 - ¾		
N.b.E.	N.b.W.	1	11	15	0	1	S.b.E.	S.b.W.
		1 - ¼	14	3	45	1 - ¼		
		1 - ½	16	52	30	1 - ½		
		1 - ¾	19	41	15	1 - ¾		
N.N.E.	N.N.W.	2	22	30	0	2	S.S.E.	S.S.W.
		2 - ¼	25	18	45	2 - ¼		
		2 - ½	28	7	30	2 - ½		
		2 - ¾	30	56	15	2 - ¾		
N.E.b.N.	N.W.b.N.	3	33	45	0	3	S.E.b.S.	S.W.b.S.
		3 - ¼	36	33	45	3 - ¼		
		3 - ½	39	22	30	3 - ½		
		3 - ¾	42	11	15	3 - ¾		
N.E.	N.W.	4	45	0	0	4	S.E.	S.W.
		4 - ¼	47	48	45	4 - ¼		
		4 - ½	50	37	30	4 - ½		
		4 - ¾	53	26	15	4 - ¾		
N.E.b.E.	N.W.b.W.	5	56	15	0	5	S.E.b.E.	S.W.b.W.
		5 - ¼	59	3	45	5 - ¼		
		5 - ½	61	52	30	5 - ½		
		5 - ¾	64	41	15	5 - ¾		
E.N.E.	W.N.W.	6	67	30	0	6	E.S.E.	W.S.W.
		6 - ¼	70	18	45	6 - ¼		
		6 - ½	73	7	30	6 - ½		
		6 - ¾	75	56	15	6 - ¾		
E.b.N.	W.b.N.	7	78	45	0	7	E.b.S.	W.b.S.
		7 - ¼	81	33	45	7 - ¼		
		7 - ½	84	22	30	7 - ½		
		7 - ¾	87	11	15	7 - ¾		
East	West	8	90	0	0	8	East	West.

J. Nozie delineavit. J. Stephenson ſculpſit.

To find the length of a Knot corresponding to a Glass running any given number of Seconds.

RULE. Add a cypher to the number of seconds run by the Glass, and divide this by 6; the quotient will be the proportional length of a knot in feet.

EXAMPLE I. What ought to be the length of a knot when the Glass runs 33 seconds?

6)330

55 feet

EXAMPLE II. Required the length of a knot corresponding to a Glass that runs 28 seconds.

6)280

46.67 or 46 feet 8 inches.

OF THE MARINERS COMPASS.

This Instrument is an artificial representation of the Horizon of any place; it consists of a circular Card, divided into 32 equal parts, by lines drawn from the center to the circumference, called RHUMB LINES, the extremities of which are termed POINTS or RHUMBS: the intervals are subdivided into halves and quarters, called HALF POINTS and QUARTER POINTS; the whole circumference is likewise divided into 360 degrees, consequently the Angle comprehended between any two Rhumbs is equal to 11 degrees 15 minutes. The four principal points are called the CARDINAL POINTS, two of which, opposite each other, are called the NORTH and SOUTH Points; that which is on the right hand when we look towards the North is termed the EAST, and its opposite the WEST Point; the names of the other points are compounded of these, according to their situation, but instead of the words, the initials only are inserted, as exhibited in Plate III., where there is also a Table, containing the measure of the Angles that each point, and quarter point, makes with the North and South, or Meridian line. Under the Card, along the North and South line, a small bar of steel is fixed, called the NEEDLE, which, being touched with a load-stone, acquires the peculiar property of pointing North and South*, and consequently by the Card determines the direction of the other points of the Horizon. The Needle, having a small socket in the center, is supported, together with the Card, on the point of a fine steel Pin, on which it freely turns, and by the above-mentioned property its points keep always in the same direction; these are confined in a circular brass box with a glass cover, the box being hung in brass hoops or gimbals, in order to counteract the motion of the Ship. The whole of these are placed in a square wooden box with a moveable lid, which serves to support the gimbals and secure the Compass from accident in removals.

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* This is not strictly true, for the Needle deviates more or less from the North and South points of the Horizon, at different places, and at different times; but as the methods by which this deviation of the Needle is found depend on Astronomical Observations, we shall defer entering into a further explanation till we treat on that subject.

The Compass is used to point out the direction that a Ship sails at Sea; for this purpose it is to be so placed in the Ship that the middle section of the wooden box, parallel to its sides, may be parallel to the middle section of the Ship along its keel; when it is thus fixed, that point of the Card which coincides with a perpendicular line, marked in the inside of the circular box, and termed by Seamen, LUBBER'S POINT, will shew the direction of the Ship's head.

The Courses and Distances which a Ship sails in 24 hours are usually set down on a board called the LOG BOARD, which will be further explained hereafter.

PLANE SAILING.

PLANE SAILING is the art of navigating a Ship upon principles deduced from the supposition of the Earth's being an extended plane. On this supposition, the Meridians are considered as being all parallel to each other, the parallels of Latitude at right Angles to the Meridians, and the length of a degree on the Meridian, Equator, and parallels of Latitude, every where equal. In this Sailing there are four principal parts, viz. the Course, Distance, difference of Latitude, and Departure.

The COURSE is the Angle which a ship's track or path makes with the Meridian, and is expressed either in points or degrees. Thus, when a Ship sails in a North East direction. we say her Course is 4 points or 45 degrees.

The DISTANCE is the number of miles, &c. between any two places reckoned on the Rhumb line of the Course; or it is the length that a ship has sailed on a direct course in a given time.

The DIFFERENCE OF LATITUDE is the distance which a Ship has made North or South of the place sailed from, and is reckoned on a Meridian.

The DEPARTURE is the East or West Distance a Ship has made from the Meridian of the place she departed from, and is reckoned on a parallel of Latitude.

Hence it is evident, that if a Ship sail due North or South she sails on a Meridian, makes no departure, and her Distance and difference of Latitude are the same: if a Ship sail due East or West she runs on a parallel of Latitude, makes no difference of Latitude, and her Departure and Distance are the same: but when a Ship sails in any other direction, she makes both difference of Latitude, and Departure, and these, with the distance, form a right angled Triangle, the Hypothenuse of which is the distance sailed, the Perpendicular is the difference of Latitude: the Base the Departure, the Angle opposite the Base is the Course, and that opposite the Perpendicular the Complement of the Course; hence, any two of these parts being given, the rest may be found by Plane Trigonometry.

When a Ship's Course is 4 points or 45 degrees, the difference of Latitude and Departure are equal; when the Course is less than 4 points or 45 degrees, the difference of Latitude is greater than the Departure; when the Course is more than 4 points or 45 degrees, the Departure is greater than the difference of Latitude.

In constructing a figure relating to a Ship's Course, let the upper part of what the figure is drawn on represent the North, then the lower part will be the South, the right hand East, and the left West.

Draw a North and South line to represent the Meridian of the place the Ship sailed from; then if the Ship's Course be to the southward, mark the upper end of the line for the place sailed from; but if the Course be northward, mark the lower end for that place.

Through the point sailed from draw a line making a right Angle with the Meridian line (Prob. XII. Geom.,) on the East or West side, according as the Ship is sailing to the eastward or westward; and that line will represent the parallel of the place the Ship sailed from.

When the Course is given, it is to be laid off from the Meridian on the arch described in making the right Angle, taken either from the line of Chords or Rhumbs, according as it is given in degrees or points.

A Line drawn from the center of the Quadrant through the point laid off for the Course will represent the distance, which, if given is to be laid thereon, beginning at the point sailed from. A line drawn from the extremity of the distance parallel to the East or West line, will determine the difference of Latitude and Departure.

If the difference of Latitude is given, it is to be laid upon the Meridian, beginning at the point representing the place the Ship left; and a line drawn from the extremity of the difference of Latitude, parallel to the East or West line, till it meets the distance produced, will form the figure.

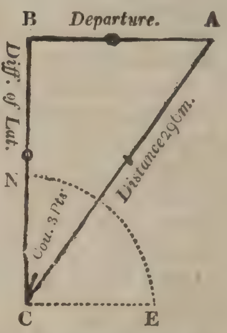
If the departure is given, it is to be drawn parallel to the East or West line, through the extremity of the difference of Latitude or Distance.

CASE I.

The Course and Distance given, to find the difference of Latitude and Departure.

Example. A Ship from Latitude 48° 40′ N., sails N. E. b. N. 296 Miles: required her present Latitude and the Departure made good.

BY CONSTRUCTION.



Draw the line BC to represent the Meridian the Ship sailed from; with the Chord of 60° in the Compasses, and one foot in C, describe the Arch NE; from N to E lay off the Chord of 90° and draw the line CE: then will NCE represent the N. E. quarter of the Compass: take the Course 3 Points in the Compasses from the line of Rhumbs, which lay off from N towards E, and through the point where it cuts the Arch draw the line CA, which make equal to the distance 296, taken from a scale of equal parts; through A draw the line BA parallel to CE (Prob. IV. Geom.;) then will BA represent the Departure equal to 164.4 miles, and CB the difference of Latitude 246 miles.

BY CALCULATION.

To find the Departure.		To find the difference of Latitude.	
As Radius .	10.00000	As Radius .	10.00000
Is to Distance 296 .	2.47129	Is to Distance 296 .	2.47129
So is Sine of Course 3 Pts.*	9.74474	So is Co. Sine of Cou. 3 Pts.	9.91985
	12.21603		12.39114
	10.00000		10.00000
To the Departure 164.4	2.21603	To the diff. of Lat. 246.1	2.39114

To find the Latitude in.

Latitude left .	48°	40	N.
Diff. of Lat. 246 miles, or	4	6	N.
Latitude in .	52	46	N.

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* The Course being given in Points, the Logarithm of its Sine, &c. is to be taken from Table XXIII.

BY INSPECTION*.

Enter the first Traverse Table, and find the Course 3 Points at the top, and in one of the columns marked Dist. find the distance 296; then opposite to this, in the columns marked Lat. and Dep. will be the difference of Latitude 246.1, and the Departure 164.4.

BY THE COMMON GUNTER.

Extend from Radius, or 8 Points, to the Course 3 Points on the line of Sine Rhumbs, marked S. R.: that extent will reach from the Distance 296, to the Departure 164.4 on the line of Numbers.

Extend from Radius, or 8 Points, to the Complement of the Course 5 Points on the line of Sine Rhumbs; that extent will reach from the Distance 296, to the Difference of Latitude 246.1 on the line of Numbers.

BY THE SLIDING GUNTER.

Set 8 Points on the line of Sine Rhumbs to coincide with the Distance 296 on the line of Numbers; then, opposite to the Course 3 Points, on the line of Sine Rhumbs, is the Departure 164.4 on the line of Numbers; and opposite the Complement of the Course 5 Points is the difference of Latitude 246.1.

CASE II.

The Course and Difference of Latitude given to find the Distance and Departure.

EXAMPLE. A Ship sails S. E. ½ E. from St. Helena, in Latitude 15° 55′ S. until by observation she is in Latitude 18° 49′ S.; required her Distance run and Departure made good.

Latitude of St. Helena	15° 55′ S.
Latitude come to .	18 49 S.
Difference of Latitude	2 54 = 174 miles.

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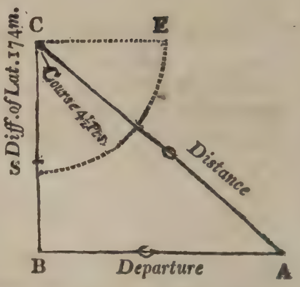
* Previous to resolving the Cases by this method, it will be necessary for the Learner to read attentively the explanation to Tables I. and II., which are constructed by this Case for every point, quarter-point, and degree of the Compass to Distances not exceeding 300.

BY CONSTRUCTION.

Draw the Meridian line CB, which make equal to the difference of Latitude 174; from C with the Chord of 60° describe the Arch SE, on which lay off 90°, and draw the line CE; from S towards E lay off the Course 4½ Points, taken from the line of Rhumbs, and through the point where it cuts the arch SE, draw the line CA; from B draw the line BA parallel to the line CE; then will the departure BA measure 212, and the distance CA 274.3 miles.



BY CALCULATION.

To find the Departure.	
As Co. Sine of Course 4½ Pts.	9.80236
Is to diff. of Latitude 174	2.24055
So is Sine of Course 4½ Pts.	9.88818
	12.12873
	9.80236
To the Departure 212	2.32637

To find the Distance.	
As Co. Sine of Course 4½ Pts.	9.80236
Is to diff. of Lat. 174	2.24055
So is Radius	10.00000
	12.24055
	9.80236
To the Distance 274.3	2.43819

BY INSPECTION.

Over the Course 4½ Points, find the Difference of Latitude 174, (or the nearest to it, which is 173.8) in a Lat. column, opposite to which will be found the Departure 211.8, and the Distance 274, in their respective columns.

BY THE COMMON GUNTER.

Extend from the Complement of the Course 3½ Points, to the Course 4½ Points, on the line of Sine Rhumbs; that extent will reach from the difference of Latitude 174 to the Departure 212 on the line of Numbers.

Extend from the Complement of the Course 3½ Points to Radius, or 8 Points, on the line of Sine Rhumbs; that extent will reach from the difference of Latitude 174 to the Distance 274.3 on the line of Numbers.

BY THE SLIDING GUNTER.

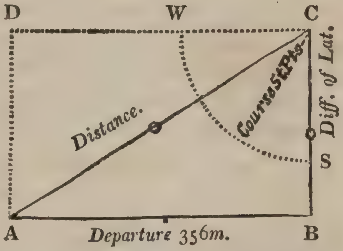
Set the difference of Latitude 174 on the line of Numbers, to the Complement of the course 3½ Points on the line of Sine Rhumbs; then, opposite the Course 4½ Points on the line of Sine Rhumbs, will be the Departure 212 on the line of Numbers, and opposite 8 Points will be the Distance 274.

CASE III.

The Course and Departure given, to find the difference of Latitude and Distance.

Example. A Ship from Lat. 3° 16′ N. sails S. W. b. W. ¼ W. until she has made 356 Miles of Departure: required her present Latitude and Distance sailed.

BY CONSTRUCTION.



Draw the Meridian line CB, and describe the Quadrant CWS to represent the S. W. quarter of the Compass: from S towards W lay off the Course 5¼ Points, and through the Point where it cuts the Arch SW draw the line CA; from C to D lay off the Departure 356, and through D draw the line DA parallel to CB, meeting the line CA in A; through A draw the line AB parallel to DC, meeting CB in B: then will the difference of Latitude CB measure 213.4, and the Distance AC 415.1.

BY CALCULATION.

To find the diff. of Latitude.		To find the Distance.	
As Sine of Course 5¼ Pts.	9.93335	As Sine of Course 5¼ Pts.	9.93335
Is to Departure 356	2.55145	Is to Departure 356	2.55145
So is Co.Si.of Course 5¼Pts.	9.71105	So is Radius	10.00000
	12.26250		12.55145
	9.93335		9.93335
To the diff. of Lat. 213.4	2.32915	To the Distance 415.1	2.61810

To find the Latitude in.

Latitude left	-	3° 16′ N.
Diff. of Lat. 213 miles, or		3 33 S.
Latitude in	-	0 17 S.

BY INSPECTION.

In that page of the Traverse Table marked with the Course 5¼ Points at the bottom, find half the given Departure, viz. 178 (the whole being too great) in the Dep. column; opposite to which, in the Lat. and Dist. columns, will be 106.9 and 208; these being multiplied by 2, give the whole difference of Latitude 213.8, and the Distance 416 miles.

BY THE COMMON GUNTER.

Extend from the Course 5¼ Points to the Complement of the Course 2¾ Points on the line of Sine Rhumbs; that extent will reach from the Departure 356 to the difference of Latitude 213.4 on the line of Numbers.

Extend from the Course 5¼ Points to 8 Points on the line of Sine Rhumbs; that extent will reach from the Departure 356 to the Distance 415.1 on the line of Numbers.

BY THE SLIDING GUNTER.

Set the Departure 356 on the line of Numbers to the Course 5¼ Points on the line of Sine Rhumbs; then, opposite the Complement of the Course 2¾ Points on the Sine Rhumbs, will be the difference of Latitude 213.4 on the line of Numbers, and opposite 8 Points the Distance 415.1.

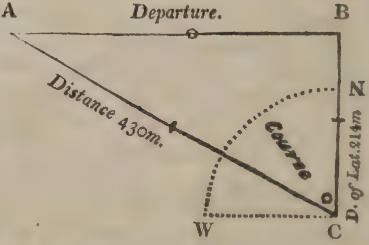
CASE IV.

The Distance and Difference of Latitude given, to find the Course and Departure.

Example. A Ship from Cape St. Vincent, in Latitude 37° 3 N. sails between the North and West 430 miles, until her difference of Latitude is 214 miles: required her Course steered and Departure made good.

BY CONSTRUCTION.

Draw the Quadrant NCW to represent the N. W. quarter of the Compass, and from C to B lay off the difference of Latitude 214; through B draw the line AB parallel to CW; with the Distance 430 in the Compasses, place one foot in C, and let the other foot cross AB in A, and draw the line AC: then will the Course BCA measure 60 degrees, and the Departure AB 373 miles.



BY CALCULATION.

To find the Course.		To find the Departure.	
As the Distance 430	2.63347	As Radius -	10.00000
Is to Radius -	10.00000	Is to Distance 430	2.63347
So is the diff. of Lat. 214	2.33041	So is Sine of Course 60° 9′	9.93819
	12.33041		12.57166
	2.63347		10.00000
To Co. Sine of Cou. 60° 9′	9.69694	To the Departure 373	2.57166

BY INSPECTION.

Seek in the several pages of the Traverse Tables until half the Distance 215, and half the difference of Latitude 107, are found opposite each other in their respective columns; against these will be found 186.2, which being doubled gives the whole Departure 372.4; and as the column where the difference of Latitude is found is marked Lat. at bottom, the Course is to be taken from thence, which in this Example is 60 degrees.

BY THE COMMON GUNTER.

Extend from the Distance 430 to the difference of Latitude 214, on the line of Numbers; that extent will reach from Radius, or 90°, to 29° 51′, the Complement of the Course on the line of Sines: hence the Course is 60° 9′.

Extend from Radius, or 90°, to the Course 60° 9′ on the line of Sines; that extent will reach from the Distance 430 to the Departure 373 on the line of Numbers.

BY THE SLIDING GUNTER.

Set the Distance 430 on the sliding line of Numbers, to the difference of Latitude 214 on the fixed line of Numbers; then, opposite to 90°, on the sliding line of sines, will be the Complement of the Course 29° 51′, on the fixed line of sines; hence the Course is 60° 9′.

Set 90° on the sliding line of Sines to the Course 60° 9′ on the fixed line of Sines; then, opposite the distance 430 on the sliding line of Numbers, will be the Departure 373 on the fixed line of Numbers.

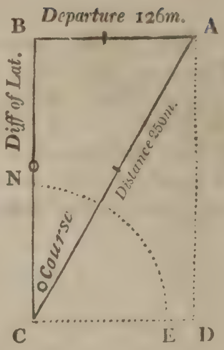
Or, reverse the slide, and set 90 on the sliding line of Sines, to the Distance 430 on the fixed line of Numbers; then, opposite the difference of Latitude 214, will be the Complement of the Course 29° 51′, and opposite the Course 60° 9′ will be the Departure 373.

CASE V.

The Distance and Departure given, to find the Course and difference of Latitude.

Example. A Ship from Latitude 1° 32′ S. sails between the North and East 250 miles, and finds she has made 126 miles of Departure: required the Course steered, and her Latitude in.

BY CONSTRUCTION.



Draw the Quadrant NCE to represent the N. E. quarter of the Compass; from C to D lay off the Departure 126, and through D draw the line DA parallel to CN produced; with the Distance 250 in the Compasses, place one foot in C, and let the other cut DA in A; draw the line AC, and through A draw the line BA parallel to CD; then the Course BCA will measure 30° 16′, and the difference of Latitude CB 215.9.

BY CALCULATION.

To find the Course.		To find the diff. of Latitude.	
As the Distance 250 .	2·39794	As Radius .	10·00000
Is to Radius .	10·00000	Is to the Distance 250	2·39794
So is the Departure 126	2·10037	So is Co. Sine of Cou. 30° 16′	9·93636
	12·10037		12·33430
	2·39794		10·00000
To Sine of Course 30° 16′	9·70243	To the diff. of Lat. 215.9	2·33430

Latitude left - - -	1° 32′ S.
Diff. of Lat 215.9 miles, or .	3 36 N.
Latitude in . .	2 4 N.

BY INSPECTION.

Seek in the Tables till opposite the Distance 250, taken in its column, the nearest to the given Departure 126 is found in its proper column, adjoining to which stands the difference of Latitude 216.5, and as the column in which the Departure is found, is marked Dep. at the top of the page; the Course is to be taken from thence, which therefore will be 30 degrees.

BY THE COMMON GUNTER.

Extend from the Distance 250 to the Departure 126 on the line of Numbers: that extent will reach from Radius, or 90°, to the Course 30° 16′ on the line of Sines.

Extend from Radius, or 90°, to the Complement of the Course 59° 44′ on the line of Sines; that extent will reach from the Distance 250 to the difference of Latitude 216 on the line of Numbers.

BY THE SLIDING GUNTER.

Set the Distance 250 on the sliding line of Numbers, to the Departure 126 on the fixed line of Numbers; then, opposite to 90°, on the sliding line of Sines, will be the Course 30° 16′ on the fixed lines of Sines.

Set 90° on the sliding line of Sines to the Complement of the Course 59° 44′ on the fixed line of Sines; then, opposite the Distance 250 on the sliding line of Numbers, will be the difference of Latitude 216 on the fixed line of Numbers.

Or, reverse the slide, and set 90° on the sliding line of Sines to the Distance 250 on the fixed line of Numbers; then, opposite the Departure 126 will be the Course 30° 16′, and opposite the Complement of the Course 59° 44′ will be the difference of Latitude 216.

CASE VI.

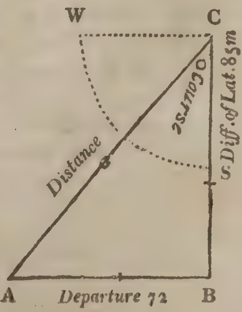
The Difference of Latitude and Departure given, to find the Course and Distance.

Example. A Ship from Funchal, in Madeira, in Latitude 32° 37′ N. sails a direct Course between the South and West until she is in Latitude 31° 12′ N. by Observation, having made 72 miles of Departure: required her Course steered and Distance run.

Latitude of Funchal	32°	37′ N.
Latitude in by Observation .	31	12 N.
Difference of Latitude .	1	25=85 miles.

BY CONSTRUCTION.

Draw the Meridian line CB, and from C describe the Quadrant CSW; from C to B lay off the difference of Latitude 85; through B draw AB parallel to CW, and equal to the Departure 72, and join AC: then the Course ACB will measure 40° 16′, and the Distance AC 111.4.



BY CALCULATION.

To find the Course.		To find the Distance.	
As the diff. of Lat. 85	1·92942	As Radius	10·00000
Is to Radius	10·00000	Is to the diff. of Lat. 85	1·92942
So is the Departure 72	1·85733	So is Sec. of Cour. 40° 16′	10·11745
	11·85733		12·04687
	1·92942		10·00000
To Tang. of Course 40°16	9·92791	**To the Distance 111.4**	2·04687

BY INSPECTION.

Seek in the different pages of the Tables till the difference of Latitude 85 and the Departure 72, or the nearest thereto, are found together in their respective columns, which will be under the Course 40 degrees; and the Distance answering to these will be 111.

Note. In this Case always seek for the larger of the two given Numbers in the column marked Lat. at the top of the page, until the smaller is found opposite to it in the column marked Dep at the top; observing, that when the Departure is more than the difference of Latitude, the Course will be at the bottom of the page.

BY THE COMMON GUNTER.

Extend from the difference of Latitude 85 to the Departure 72 on the line of Numbers; that extent will reach from Radius, or 45°, to the Course 40° 16′ on the line of Tangents.

Extend from the Complement of the Course 49° 44′ to 90° on the line of Sine, that extent will reach from the difference of Latitude 85 to the Distance 111.4 on the line of Numbers.

BY THE SLIDING GUNTER.

Set the Difference of Latitude 85 on the sliding line of Numbers to the Departure 72 on the fixed line of Numbers; then, opposite 45°, on the sliding line of Tangents, will be the Course 40° 16′ on the fixed line of Tangents.

Set the Complement of the Course 49° 44′ on the sliding line of Sines, to 90° on the fixed line of Sines; then, opposite the difference of Latitude 85, on the sliding line of Numbers, will be the Distance 111.4 on the fixed line of Numbers.

QUESTIONS FOR EXERCISE.

1. A Ship from Latitude 36° 30′ N. sails S. W. by W. 420 miles: what is her present Latitude, and what Departure has she made?

Ansr. Latitude in 32° 37′ N. and Departure 349.3 miles.

2. A Ship from Latitude 3° 54′ S. has sailed N.W. ¾ W. till she arrives at Latitude 2° 14′ N.: required her Distance run, and Departure made good.

Ansʳ. Distance 617.8, and Departure 496.2 miles.

3. A Ship from St. Helena, in Latitude 15° 55′ S. sails S. S. E. ½ E. till she has made 115 miles of Departure: I demand her present Latitude, and the Distance she has run.

Ansʳ. Latitude in 19° 30′ S. and Distance 244 miles.

4. A Ship from Latitude 28° 20′ N. sails north easterly 486 miles, and finds by Observation, that she is in Latitude 32° 17′ N.: what Course has she steered, and what Departure has she made.

Ansʳ. Course N. 60° 49′ E. or N. E. b. E. ½ E. nearly, and Departure 424.3 miles.

5. A Ship sails between the North and West 170 leagues from a port in Latitude 38° 42′ N., until her Departure be 98 leagues: required her Course and Latitude in.

Ansʳ. Course N. 35° 12′ W., or N. W. b. N. ¼ W. nearly, and Latitude in 45° 39′ N.

6. A Ship from the Lizard, in Latitude 49° 58′ N. sails to the westward on a direct Course, till she arrives at Latitude 48° 11′ N., and finds she has made 87 miles of westing: required her Course steered, and Distance run.

Ansʳ. Course S. 39° 7′ W., or S. W. b. S. ½ W. nearly, and Distance 137.9 miles.

TRAVERSE SAILING.

WHEN a Ship, either from contrary Winds or other causes, is obliged to sail on different Courses, the irregular or zig-zag track she makes is called a TRAVERSE, or COMPOUND COURSE; and the method of reducing these several Courses and Distances into a single Course and Distance, is called resolving a Traverse.

To resolve a Traverse, make a Table, (as that in Example I.) and divide it into six columns; in the first of these set down the several Courses, and opposite to them, in the second column their corresponding Distances; the third and fourth columns are to be marked N. S. at the top, and are to contain the differences of Latitude; the fifth and sixth are to be marked E. W., to contain the Departures.

Find the difference of Latitude and Departure corresponding to each Course and Distance, by any of the methods in Case I. of

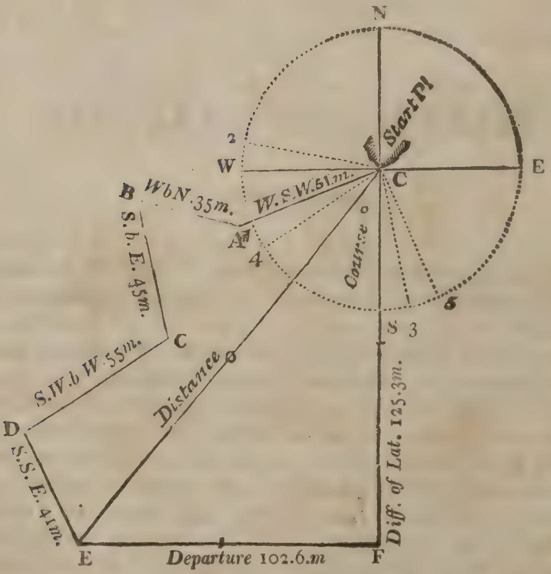
Plane Sailing, the most common of which is Inspection; set these down opposite the Distance in their proper columns, observing that the difference of Latitude must be placed in the North column, if the Course be northerly, and in the South column if the Course be southerly; and that the Departure must be placed in the East column, if the Course be easterly, and in the West column, if it be westerly. When the Course is due North, South, East, or West, set down the Distance in that column answering to it. Add up the columns of northing, southing, easting, and westing, and set down the sum of each at the bottom; then the difference between the sums of the North and South columns will be the whole difference of Latitude made good, of the same name with the greater; and the difference between the sums of the East and West columns is the whole Departure made good, of the same name with the greater sum.

With this whole difference of Latitude and Departure made good, find the direct Course and Distance, as in Case VI. of Plane Sailing.

EXAMPLE I.

Suppose a Ship from the Start, in Latitude 50° 13′ N., sails W.S.W. 51 miles, W. b. N. 35 miles, S. b. E. 45 miles, S. W. b. W. 55 miles, and S. S. E. 41 miles: required her direct Course and Distance sailed, and her Latitude in.

BY CONSTRUCTION.



With the Chord of 60° describe the Circle NESW, to represent the Compass; draw the diameters NS and EW at right Angles, the one representing the Meridian, and the other the Parallel the Ship sailed from: take each Course from the line of Rhumbs, and lay them off from the Meridian in their respective quarters, and number them in order 1, 2, 3, 4, &c.; thus, from S. to 1 lay off 6 points for the first Course W. S. W.; from N. to 2 lay off 7 points for the second Course W. b. N.; from S. to 3 lay off one point for the third Course S. by E.; from S. to 4 lay off 5 points for the fourth Course S.W.b.W.; from S. to 5 lay off 2 points for the fifth Course S. S. E.; and from the centre of the Circle draw Rhumb lines to each of these points, which may be produced to any length that is necessary. Upon the first Rhumb C 1, lay off the first distance 51 miles, from C to A; then will A represent the Ship's place at the end of the first Course; through A draw AB parallel to the second Course C 2, (Prob. IV. Geom.) and make it equal to the second Distance 35 miles; through B draw BC parallel to C 3, and equal to 45 miles: through C draw CD parallel to C 4, and equal to 55 miles; and through D draw DE parallel to C 5, and equal to 41 miles. Through E draw the line EF parallel to the East and West line WE, meeting NS produced in F, and join CE. Then will CF be the difference of Latitude made good, measuring 125.3; EF the Departure 102.6, CE the Distance 162, and the Angle ECF the Course 39° 19′, or 3½ Points.

TRAVERSE TABLE.

Courses.	Dist.	Diff. of Lat.		Departure.	
		N.	S.	E.	W.
W. S. W.	51		19·5		47·1
W. b. N.	35	6·8			34·3
S. b. E.	45		44·1	8·8	
S.W.b.W.	55		30·6		45·7
S. S. E.	41		37·9	15·7	
		6·8	132·1	24·5	127·1
			6·8		24·5
	Diff.of Lat.		125·3	Dep.	102·6

Lat. left .	50°	13′ N.
Diff. of Lat. 125, or	2	5 S.
Latitude in .	48	8 N.

To find the Course and Distance made good.

BY CALCULATION.

To find the Course.		To find the Distance.	
As diff. of Lat. 125.3	2·09795	As Radius .	10·00000
Is to Radius .	10·00000	Is to diff. of Lat. 125.3	2·09795
So is Departure 102.6	2·01115	So is Sec. of Cou. 39° 19′	10·11145
	12·01115		12·20940
	2·09795		10·00000
To Tang. Course 39° 19	9·91320	To the Distance 162 .	2·20940

Hence the direct Course made good is S. 39° 19′ W. or S.W.b.S½W. and the Distance 162 miles.

BY INSPECTION.

Seek in the Traverse Table till the difference of Latitude 125.3, and Departure 102.6, are found opposite each other in their respective columns; the nearest to these will be 125.2 and 102.8, which give the Course 3½ Points at the top, and the Distance 162 in its column.

EXAMPLE II.

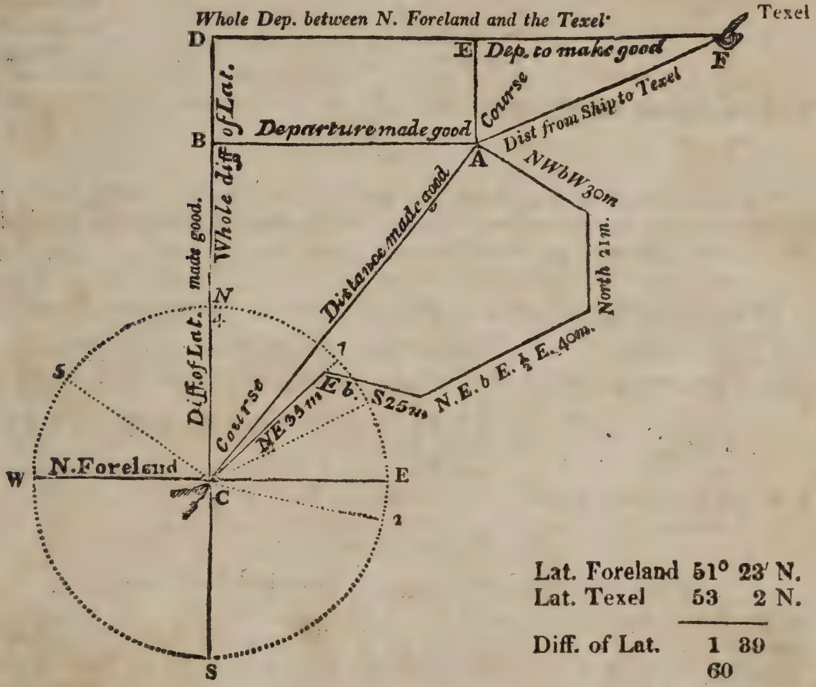
A Ship from the North Foreland, in Latitude 51° 23′ N. and bound to the Texel, which lies in Latitude 53° 2′ N., and 115 miles to the Eastward, sails N. E. 35 miles, E. b. S. 25 miles, N. E. b. E. ½ E. 40 miles, North 21 miles, N. W. b. W. 30 miles: required her Course and Distance made good, the Latitude she is in, and Departure from the Meridian; also the direct Course and Distance from the Ship to the Texel.

BY CONSTRUCTION.

With the Chord of 60° describe a Circle, through the center of which draw the North and South, or Meridian line, N. S, and at right Angles to it the East and West line W. E.; lay off from the Meridian, upon the circumference of the Circle, the several Courses in their proper quarters, number them in order, and draw a Rhumb line from the center to each of the Points; then, on the first Rhumb line, which is N. E. or 4 Points, lay off the Distance 35 from the center, and through the end of this first Distance draw a line parallel to the second Rhumb, E. b. S. 7 Points, on which lay off the second Distance 25; proceed thus till all the Courses and Distances are laid off, and through the end of the last distance draw the line AB parallel to the line W. E. meeting S. N. produced in B; then will A represent the Ship's place, CB will measure the difference of Latitude made good 76.4, BA the Departure 59.6, CA the Distance run 97, and the Angle BCA the Course steered 38 Degrees.

To find what Course the Ship must steer, and what Distance she must run, before she can arrive at the Texel, lay off from C to D 99, the whole difference of Latitude between the Foreland and the

Texel, and through D draw DF parallel to W. E. and equal to the whole Departure 115, then will F represent the situation of the Texel: through A draw AE parallel to CD and join AF; then AE will be the Northing or difference of Latitude 23, and EF the Easting, or Departure 55, the Ship has to make good; AF the Distance the Ship has to sail 60, and the Angle EAF measuring 67° 27′, the Course from the Ship to the Texel.



Lat. Foreland 51° 23′ N.
Lat. Texel 53 2 N.

Diff. of Lat. 1 39
60

Miles 99

TRAVERSE TABLE.

Courses.	Dist.	Diff. of Lat.		Departure.	
		N.	S.	E.	W.
N. E.	35	24·7		24·7	
E. b. S.	25		4·9	24·5	
N. E. b. E. ½ E.	40	18·9		35·3	
North	21	21·0			
N. W. b. W.	30	16·7			24·9
		81·3	4·9	84·5	24·9
		4·9		24·9	
	Diff. of Lat.	76·4	Dep.	59·6	

To find the Course and Distance made good.

BY CALCULATION.

To find the Course.		To find the Distance.	
As diff. of Lat. 76.4 .	1·88309	As Radius .	10·00000
Is to Radius .	10·00000	Is to diff. Lat. 76·4 .	1·88309
So is Departure 59.6	1·77525	So is Sec. Course 37° 58″	10·10327
	11·77525		11·98636
	1.88309		10·00000
To Tang. Course 37° 58′	9·89216	To the Distance 96·91	1·98636

BY INSPECTION.

The Difference of Latitude 76.4 and Departure 59.6 being looked for till they are found opposite each other in their respective columns, give the Course 38°, and the Distance 97 miles.

To find the direct Course and Distance from the Ship to the Texel.

Lat. of N. Foreland .	51° 23′ N.	Whole Departure	115m. E.
Diff. of Lat. made good 76m. or	1 16 N.	Dep. made good	59·6 E.
Latitude in . .	52 39 N.	Dep. to make good	55·4 E.
Lat. of Texel .	53 2 N.		
Diff. of Lat to make good .	0 23 N.		

BY CALCULATION.

To find the Course.		To find the Distance.	
As the diff. of Lat. 23	1·36173	As Radius .	10·00000
Is to Radius .	10·00000	Is to diff. of Lat. 23	1·36173
So is Departure 55·4	1·74351	So it Sec. Course 67° 27′	10.41625
	11·74351		11·77798
	1·36173		10·00000
To Tang. Course 67° 27′	10·38178	To the Distance 59·98	1·77798

BY INSPECTION.

The Departure 55.4 and difference of Latitude 23 being looked for in the Tables till they are found together, the nearest answering to them will be over the Course 6 Points, and opposite the Distance 60 miles.

QUESTIONS FOR EXERCISE.

1. A Ship from the Lizard, in Latitude 49° 58′ N. sails as follows: S. b. W. 42 miles, W. S. W. 36 miles, West 18 miles, E.S.E. 22 miles;

South 34 miles, and N. E. 21 miles: required her present Latitude, and the direct Course and Distance made good.

Ans. Her Latitude in is 48° 35′ N.; the Course made good S. 16° 27′ W. or S. b. W. ½ W. nearly, and the Distance 86.13 miles.

2. A Ship from a Port in Latitude 38° 42′ N., bound to another Port situated in Latitude 36° 32′ N., and 137 miles to the Eastward, sails the following Courses; S. b. W. ½ W. 55 miles, S. W. b. S. ½ W. 37 miles, South 60 miles, E. S. E. 40 miles, S. E. b. S. ¼ E. 32 miles, and N. E. b. E. ½ E. 58 miles: required her direct Course and Distance made good, her present Latitude, and the direct Course and Distance to her intended Port.

Ans^{r}. The Course made good is S. 23° 38′ E. and the Distance 169 miles; the Latitude in 36° 7′ N., the Course to the intended Port N. 70° 8′ E., and the Distance 73.56 miles.

3. The Course (by Compass) from Beachy Head to Selsea Bill is N. 67° W. and Distance 40 miles; from Selsea Bill to St. Catherine's Point N. 86° W. 21 miles; from St. Catherine's Point to Portland Lights N. 69° W. 14 miles; from Portland Lights to the Start N. 85° W. 49 miles: required the Course and Distance from Beachy Head to the Start.

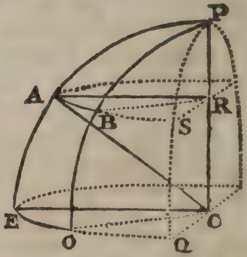
Ans^{r}. The Course is N. 75° 51′ W. or W. N. W. ¾ W., and Distance 152.2 miles.

PARALLEL SAILING.

In Plane Sailing it was observed that the Meridians are considered as being all parallel to each other, and the length of a degree on the Meridian and Parallel every where equal, which supposition will give just conclusions, so far as the Course, Distance, difference of Latitude and Departure, are concerned, because a Ship, when sailing on a Rhumb, makes equal Angles with the Meridians: but as the Earth is a Sphere, or Globe, and the Meridians meet at the Poles, it is evident that the Distance between any two Meridians must vary in every Latitude, their greatest Distance being at the Equator, on which the difference of Longitude is measured; hence the difference of Longitude always exceeds the Departure, or meridian Distance, (except on the Equator, where they are the same) in proportion as the given places are situated further from the Equator.

PARALLEL SAILING is the method of finding the Distance between two places in the same Latitude when their difference of Longitude is known, or of finding the difference of Longitude answering to the Distance or Departure made good, when a Ship sails due East or West.

This sailing is particularly useful in making small or low Islands, in which case it is usual to run into the Latitude, and then steer due East or West.



The Principles upon which Parallel Sailing depend, may be thus illustrated: Let PAEC represent a Section of one fourth part of the Earth, through the center C, and one of the Poles P; then PAE will be part of a Meridian, PC the Polar, and EC the equatorial Semi-axis; also let PBO represent part of another Meridian, A and B two places in the same parallel, being equally distant from the Equator EOQ; then will AB be the meridian Distance, and EO their difference of Longitude; the Arches AE or BO will measure their Latitude, and AP or BP their Co. Latitude; AR, the radius of the parallel ABS will be the Sine of the Arch AP, the Co. Latitude; or Co. Sine of AE, the Latitude of A or B. Now the Angles ARB and ECO being equal, the Arches AB and EO are similar, and as Circles and similar Arches of Circles are in direct ratio to their radii, therefore

EC (or AC) : EO :: AR : AB .

That is, As Radius	Or, As Radius,
Is to difference of Long.	Is to any given portion of Equator
So is Co. Sine of Latitude	So is Co. Sine of Latitude
To the meridian Distance	To a similar portion of given parallel

And, AR : AB :: EC (or AC) : EO.	Also, EO : EC :: AB : AR.
That is, As Co. Sine of Latitude	That is, As difference of Longitude
Is to meridian Distance	Is to Radius
So is Radius	So is meridian Distance
To difference of Longitude	To Co. Sine of Latitude

Hence, if a Triangle, as ABC (see Figure in Case I.) be so constructed that the longest side AC may represent the difference of Longitude in miles, the Base AB the meridian distance, and the Angle opposite to it ACB, the Co. Latitude, consequently the other Angle BAC equal to the Latitude, and any two of these parts be given, the other may be found by Trigonometry

CASE I.

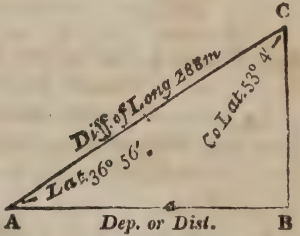
The difference of Longitude between two Places, both in one parallel of Latitude given, to find their Distance.

EXAMPLE A Ship in Latitude 36° 56′ N. and Longitude 20° 17′ W. is bound to St. Mary's, one of the Western Islands, in the same Latitude, and in Longitude 25° 5′ W., what Distance must she run to arrive at the Island?

	90° 0′	Longitude of Ship .	20° 17′ W.
Latitude	36 56	Longitude of St. Mary	25 5 W.
Co. Latitude	53 4	Diff. of Longitude .	4 48=288 miles.

BY CONSTRUCTION.

Draw the line AB of any length, and make the Angle CAB equal to the Latitude 36° 56′ (Prob. XII. Geom.;) from A to C lay off the difference of Longitude 288, and from C draw CB perpendicular to AB (Prob III. Geom.); then will AB measure 230, the Departure or Distance required.



BY CALCULATION.

As Radius . . .	10.00000
Is to the difference of Longitude AC 288 .	2 45939
So is the Co. Sine of Latitude 36° 56′ .	9.90273
	12.36212
	10.00000
To the Distance AB 230.2 . .	2.36212

BY INSPECTION.

Seek for the Complement of the Latitude 53° among the degrees in the Traverse Table, as if it were a Course, and for the difference of Longitude 288 in one of the Distance Columns of that page, opposite to which, in the Departure column, will be found 230, the Departure or Distance required.

BY THE COMMON GUNTER.

Extend from 90° to the Co. Latitude 53° 4′ on the line of Sines; that extent will reach from the difference of Longitude 288 to the Distance 230, on the line of Numbers.

BY THE SLIDING GUNTER.

Set 90° on the sliding line of Sines to the Co. Latitude 53° 4′ on the fixed line of Sines; then, opposite to the difference of Longitude 288 on the sliding line of Numbers, will be 230 the Distance, on the fixed line of Numbers.

By this Case the meridian Distance in miles and decimal parts, answering to a degree of Longitude in any parallel of Latitude may be found. Suppose, for example, it were required to find the number of Miles contained in a degree of Longitude in Latitude 45°.

As Radius . . .		10.00000
Is to Co. Sine of Latitude . .	45°	9.84949
So is the miles in a Degree of Longitude at Equator	60	1.77815
		11.62764
		10.00000
To the miles in a deg. of Long. in the given parallel	42.43	1.62764

CASE II.

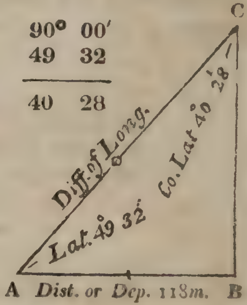
The Distance between two places both in the same parallel of Latitude given, to find the difference of Longitude.

Example. A Ship from Latitude 49° 32′ N. and Longitude 10° 16′ W. sails due West 118 miles: required her present Longitude.

BY CONSTRUCTION.

Draw the line AB, which make equal to the given Distance 118, and make the Angle CAB equal to the Latitude 49° 32′ (Prob. XII. Geom.;) upon B erect the Perpendicular BC, cutting the line AC in C; (Prob. II. Geom.) then will the line AC measure 182, the difference of Longitude required.

	90°	00′
Lat. .	49	32
Co. Lat.	40	28



BY CALCULATION.

As Co. Sine of Lat. 49° 32′	9·81225
Is to the Distance AB 118	2·07188
So is Radius .	10·00000
	12·07188
	9·81225
To the diff. of Long. 181·8	2·25963

Long. left .	10°	16′ W.
Diff. of Long. 182m. or	3	2 W.
Longitude in .	13	18 W.

BY INSPECTION.

Look for the Co. Latitude 40° in the Table, as a Course, and for the Distance 118 in one of the Departure columns, opposite to which, in the Distance column, will be found 184; but as the Co. Latitude is nearly half way between 40° and 41°, look again in the page with 41° at the top, for the Distance 118 in one of the Departure columns, and opposite in the Distance column will be found 180; then half the sum of this and 184, found before, will be 182, the difference of Longitude

BY THE COMMON GUNTER.

Extend from the Co. Latitude 40° 28′ to Radius 90° on the line of Sines; that extent will reach from the Distance 118 to the difference of Longitude 182 miles

BY THE SLIDING GUNTER.

Set the Co. Latitude 40° 28′ on the sliding line of Sines to 90° on the fixed line of Sines; then, opposite to the Distance 118 on the sliding line of Numbers, will be the difference of Longitude 182 on the fixed line of Numbers.

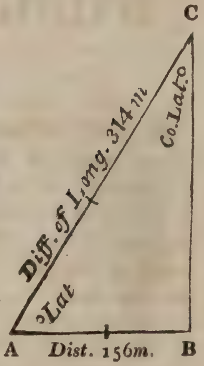
CASE III.

The difference of Longitude and Distance between two places in the same parallel of Latitude given, to find the Latitude of that parallel.

Example. A Ship sails due East 156 miles, and then finds she has altered her Longitude 314 miles: required the Latitude of the parallel she has sailed on.

BY CONSTRUCTION.

Draw the line AB, and make it equal to the Distance 156; on B erect the perpendicular BC, and with an extent in the Compasses equal to the difference of Longitude 314, set one foot in A, and with the other describe an arch cutting BC in C, and draw the line AC; then the Angle CAB will measure 60° 13′ (Prob. XIII. Geom.) the Latitude required.



BY CALCULATION.

As the difference of Longitude	AC 314	2.49693
Is to Radius		10.00000
So is the Distance	AB 156	2.19312
		12.19312
		2.49693
To Co. Sine of the Latitude 60° 13′		9.69619

BY INSPECTION.

Seek in the several pages of the Table till half the difference of Longitude and Distance, viz. 157 and 78, (the whole exceeding the limits of the Table) are found opposite each other in the Distance and Departure columns, which will give the Co. Latitude 30° at the top of the page, and consequently the Latitude required will be 60°.

BY THE COMMON GUNTER.

Extend from the difference of Longitude 314 to the Distance 156 on the line of Numbers; that extent will reach from 90° to the Complement of the Latitude 29° 47′ on the line of Sines. Hence the Latitude required is 60° 13′.

BY THE SLIDING GUNTER.

Set the difference of Longitude 314 on the sliding line of Numbers, to the Distance 156 on the fixed line of Numbers; then, opposite 90° on the sliding line of Sines, will be the Co. Latitude 29° 47′ on the fixed line of Sines. Hence the Latitude required is 60° 13′.

MIDDLE LATITUDE SAILING.

WHEN a Ship sails due North or South, she keeps on the same Meridian, and therefore does not change her Longitude, and her Distance run is the difference of Latitude; consequently her place is easily determined by the Latitude left and difference of Latitude: Again, when a Ship sails due East or West, her difference of Longitude is found by the Latitude in, and Departure or Meridian Distance, as already explained in Parallel Sailing; but when she sails upon any other Course, she changes both her Latitude and Longitude. Now the difference of Longitude cannot be inferred either from the Departure, considered as a meridian Distance in the Latitude left, or that come to, for in the greater Latitude it would give the difference of Longitude too much, and in the lesser Latitude too little; the Departure is therefore accounted a meridian Distance in the mean of the two Latitudes, and then the difference of Longitude is found as in Parallel Sailing; hence this Method, which is compounded of Plane and Parallel Sailing, is called MIDDLE LATITUDE SAILING.

The Middle Latitude is half the sum of the two Latitudes when they are of the same name; or half their difference if of contrary names.

This method of Sailing although not strictly accurate, especially in high Latitudes, approaches sufficiently near the truth for a day's run; but it is used principally in low Latitudes, and when the Ship makes a Course nearly East or West.

CASE I.

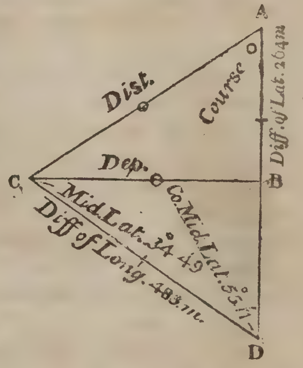
The Latitudes and Longitudes of two Places given, to find the Course and Distance between them.

EXAMPLE. Required the Course and Distance from Cape St. Vincent, in Latitude 37° 1′ N. and Longitude 9° 2′ W. to Funchal, in Madeira, in Latitude 32° 37′ N. and Longitude 17° 5′ W.

Lat. Cape St. Vincent	37° 1′N.	—	37° 1′	Long. C. St. Vinc.	9° 2′ W.
Lat. Funchal .	32 37 N.	—	32 37	Long. Funchal	17 5 W.
Diff. of Latitude	4 24	Sum 2)	69 33	Diff. of Long.	8 3
	60				60
		Mid.Lat.	34 49		
In miles .	264		90 0	In miles	483
		Co. Mid. Lat.	55 11		

BY CONSTRUCTION.

Draw the line AD to represent the Meridian of Cape St. Vincent; make the Angle ADC equal to the Co. Mid. Lat. 55° 11′, (Prob. XII. Geom.) and from D to C lay off the difference of Longitude 483; from C draw the line BC perpendicular to AD, (Prob. III. Geom.) make BA equal to the difference of Latitude 264, and draw the line AC: then will BC represent the Departure=396.5, the Angle BAC the Course = 56° 21′, or 5 Points; and AC the Distance=476.4.



BY CALCULATION.

To find the Departure.

As Radius	-	10.00000
Is to diff. of Long.	483	2.68395
So is Co.Sine mid.lat.	34°49′	9.91433
		12.59828
		10.00000
To the Departure	396.5	2.59828

To find the Course.

As diff. of Lat.	264	2.42160
Is to Radius	-	10.00000
So is Departure	396.5	2.59824
		12.59824
		2.42160
To Tang. Course	56° 21	10.17664

To find the Course without Dep*.

As diff. of Lat. 264	2.42160
Is to diff. of Long. 483	2.68395
So is Co.Sine mid. lat. 34°49′	9.91433
	12.59828
	2.42160
To Tang. Course 56°21′	10.17668

To find the Distance.

As Radius .	10.00000
Is to the diff. of Lat. 264	2.42160
So is Sec. Course 56° 21′	10.25640
	12.67800
	10.00000
To Distance 476.4	2.67800

Hence the Course from Cape St. Vincent to Funchal is S. 56° 21′ W. or S. W. b. W., and the Distance 476 miles.

BY INSPECTION.

Look for the Co. Middle Latitude 55°, as if it were a Course, and for 241, half the difference of Longitude (the whole being too great) in a Distance column, immediately opposite to which, in the Departure column, will be found 197.4; this multiplied by 2, gives the Departure 394.8.

Then 132, half the difference of Latitude, and 197.4, half the Departure, being found opposite each other in their respective columns, will give the Course 5 Points, and half the Distance 237, which multiplied by 2, gives the Distance 474 miles.

BY THE COMMON GUNTER.

Extend from 90° to the Complement of Middle Latitude 55° 11′ on the line of Sines; that extent will reach from the difference of Longitude 483 to the Departure 396.5 on the line of Numbers.

Extend from the difference of Latitude 264 to the Departure 396.5 on the line of Numbers; that extent will reach from 45° to the Course 56° 21′ on the line of Tangents.

Extend from the Complement of the Course 33° 39′ to 90° on the line of Sines; that extent will reach from the difference of Latitude 264 to the Distance 476.4 on the line of Numbers.

BY THE SLIDING GUNTER.

Set 90° on the sliding line of Sines, to the Co. Mid. Lat. 55° 11′ on the fixed line of Sines; then, opposite the difference of Longitude 483 on the sliding line of Numbers, will be the Departure 395.6 on the fixed line of Numbers.

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* This proportion is deduced from the two preceding, as may be thus demonstrated: First, Rad. : diff. Long. : : Co. S. Mid. Lat. : Depr.; therefore Rad × Dep. = Co S. Mid. Lat. × diff. Long.; also, Diff. Lat. : Rad. : : Depr. : Tang. Course; therefore Rad. × Dep, = Diff. Lat. × Tang. Course; consequently Diff. Lat. × Tang. Course = Co. S. Mid. Lat. × Diff. Long.; whence Diff. Lat : Co. S. Mid. Lat : : Diff. Long. : Tang. Course; or, Diff. Lat. : Diff. Long. : : Co. S. Mid. Lat. : Tang. Course.

Set the diff. of Latitude 264 on the sliding line of Numbers to the Departure 396.5 on the fixed line of Numbers; then, opposite 45° on one of the lines of Tangents, will be the Course 56° 21′ on the adjacent line of Tangents.

Set the Complement of the Course 33° 39′ on the sliding line of Sines to 90° on the fixed line of Sines; then, opposite the difference of Latitude 264 on the sliding line of Numbers, will be the Distance 476.4 on the fixed line of Numbers.

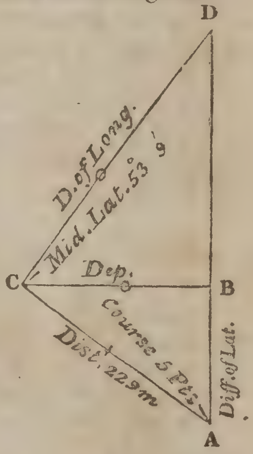
CASE II.

One Latitude, Course, and Distance given, to find the difference of Latitude and Longitude.

Example. A Ship from Lat. 52° 6′ N. and Long. 35° 6′ W. sails N.W. b. W. 229 miles: required her present Latitude and Longitude.

BY CONSTRUCTION.

Draw the line AD, and make the Angle DAC equal to the Course 5 Points; lay off, from A to C, the Distance 229, and draw the line CB perpendicular to the line AD; then will the Departure CB measure 190.4, and the diff. of Latitude AB 127: hence the Latitude in is 54° 13′, and the Middle Latitude 53° 9′. Now make the Angle BCD equal to the Middle Latitude 53° 9′, then will CD be the difference of Longitude measuring 317.4 miles.



BY CALCULATION.

To find the diff. of Latitude.

As Radius	.	10.00000
Is to Distance 229		2.35984
So is Co. Sine Course 5 Pts.		9.74474
		12.10458
		10.00000
To the diff. of Lat. 127.2		2.10458

Diff. of Lat. 127 miles, or	2°	7′ N.
Latitude left .	52	6 N.
Latitude in .	54	13 N.
Sum of Latitudes 2)	106	19
Middle Latitude .	53	9
	90	0
Co. Mid. Latitude	36	51

To find the Departure.

As Radius	.	10.0000
Is to Distance	229	2.35984
So is Sine Course	5 Pts.	9.91985
		12.27969
		10.00000
To the Departure	190.4	2.27969

To find the diff. of Longitude.

As Co. Sine Mid. Lat.	53° 9′	9.77795
Is to Departure	190.4	2.27967
So is Radius		10.00000
		12.27967
		9.77795
To the diff. of Long.	317.5	2.50172

To find diff. Long. without Dep.*

As Co. Sine Mid. Lat. 53°9′	9.77795
Is to diff. of Lat. 127.2	2.10449
So is Tang. Course 5 Pts.	10.17511
	12.27960
	9.77795
To the diff. of Long. 317.4	2.50165

Longitude left .	35° 6′ W
Diff. of Long. 317m. or	5 17 W.
Longitude in .	40 23 W.

BY INSPECTION.

Look for the Course 5 Points at the bottom of the pages, over which, and opposite the Distance 229 in its column, will be the diff of Latitude 127.2 and Departure 190 4 in their respective columns.

Look for the Co. Mid. Latitude 37° (being the nearest to 36° 51′) as if it were a Course, and for half the Departure 95.2 in its column, opposite the nearest to which, in the Distance column, will be found 158, this, multiplied by 2, gives the difference of Longitude 316 miles.

BY THE COMMON GUNTER.

Extend from 8 Points to the Complement of the Course 3 Points on the line of Sine Rhumbs; that extent will reach from the Distance 229 to the difference of Latitude 127.2.

Extend from 8 Points to the Course 5 Points on the line of Sine Rhumbs; that extent will reach from the Distance 229 to the Departure 190.4.

Extend from the Co. Mid. Latitude 36° 51′ to 90° on the line of Sines; that extent will reach from the Departure 190.4 to the diff. of Longitude 317.4.

BY THE SLIDING GUNTER.

Set 8 Points on the line of Sine Rhumbs to the Distance 229 on the line of Numbers; then, opposite the Course 5 Points will be the Departure 190.4, and opposite the Complement of the Course 3 Points will be the difference of Latitude 127.2.

Set the Co. Mid. Latitude 36° 51′ on the sliding line of Sines to 90° on the fixed line of Sines; then, opposite the Departure 190.4 on the sliding line of Numbers, will be the difference of Longitude 317.4 on the fixed line of Numbers.

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* Or, by considering the whole Figure ACD as an Oblique-Angled Triangle, it may be stated thus: as Co. Sine Mid. Lat. is to Distance, so is Sine Course to diff. of Longitude.

CASE III.

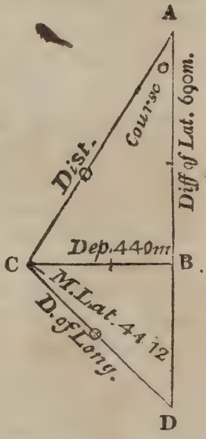
Both Latitudes and Departure given, to find the Course, Distance, and Difference of Longitude.

Example. A Ship from Latitude 49° 57′ N. and Longitude 5° 11′ W. sails between the South and West until she arrives in Latitude 38° 27′ N. and finds she has made 440 miles of Departure: required the Course she has steered, the Distance run, and the Longitude she is in.

Latitude left	49° 57′ N.	.	49° 57′ N.
Latitude in	38 27 N.	.	38 27 N.
Diff. of Lat.	11 30	Sum 2)	88 24
	60		
		Mid. Lat.	44 12
In miles	690		90 00
		Co. Mid. Lat.	45 48

BY CONSTRUCTION.

Draw the line AD, and from A to B lay off the difference of Latitude 690; on B erect the Perpendicular BC, which make equal to the Departure 440, and join AC: draw the line CD so as to make an Angle with CB equal to the Middle Latitude 44° 12′; then the Course CAB will measure 32° 31′, the Distance AC 818.5, and the Difference of Longitude DC 613.7.



BY CALCULATION.

To find the Course.

As diff. of Lat.	690	2.83885
Is to Radius	.	10.00000
So is Departure	440	2.64345
		12.64345
		2.83885
To Tang. Course 32° 31′		9.80460

To find the Distance.

As Sine of Course 32° 31′		9.73042
Is to Departure	440	2.64345
So is Radius		10.00000
		12.64345
		9.73042
To the Distance 818.5		2.91303

To find the diff. of Longitude.

As Co. Sine Mid. Lat. 44° 12′		9.85547
Is to Departure	440	2.64345
So is Radius	.	10.00000
		12.64345
		9.85547
To diff. of Long. 613.7		2.78798

To find the Longitude in.

Longitude left	.	5° 11′ W.
Diff. of Long. 614m. or		10 14 W.
Longitude in	.	15 25 W

BY INSPECTION.

One fourth the difference of Latitude and Departure, that is, 172.5 and 110, are found to correspond nearly under 32° and 33°, the Departure opposite the difference of Latitude 172.5 being too little under 32° and too much under 33°, therefore the Course is about 32½ degrees, and the distances answering to these are 203 and 206: their sum 409, divided by 2, gives one fourth the Distance 204.5, which, multiplied by 4, gives the whole Distance 818.

The Complement of Middle Latitude 46° taken as a Course, with one fourth the Departure 110 in its column, gives in the Distance column 153; this, multiplied by 4, will be the difference of Longitude 612.

BY THE COMMON GUNTER.

Extend from the difference of Latitude 690, to the Departure 440 on the line of Numbers; that extent will reach from 45° to the Course 32° 31′ on the line of Tangents.

Extend from the Course 32° 31′ to 90° on the line of Sines; that extent will reach from the Departure 440 to the Distance 818.5 on the line of Numbers.

Extend from the Co. Mid. Lat. 45° 48′ to 90° on the line of Sines; that extent will reach from the Departure 440 to the diff. of Longitude 613.7 on the line of Numbers.

BY THE SLIDING GUNTER.

Set the difference of Latitude 690 on the sliding line of Numbers, to the Departure 440 on the fixed line of Sines; then, opposite 45° on one of the lines of Tangents will be the Course 32° 31′ on the corresponding line of Tangents.

Set the Course 32° 31′ on the sliding line of Sines, to 90° on the fixed line of Sines; then, opposite the Departure 440 on the sliding line of Numbers will be the Distance 818.5 on the fixed line of Numbers.

Set the Co. Mid. Lat. 45° 48′ on the sliding line of Sines, to 90° on the fixed line of Sines; then, opposite the Departure 440 on the sliding line of Numbers, will be the difference of Longitude 613.7 on the fixed line of Numbers

CASE IV.

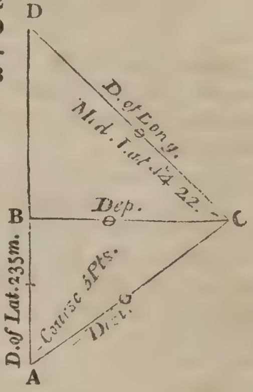
Both Latitudes and Course given, to find the Departure, Distance, and Difference of Longitude.

Example. A Ship from Latitude 42° 25′ N. and Longitude 15° 6′ W. sails N. E. b. E. for several days, and then finds by observation that she is in Latitude 46° 20′ N.: required the Distance she has sailed and her present Longitude.

Latitude left	42° 25′ N.	.	42° 25′ N.
Latitude by Obs.	46 20 N.	.	46 20 N.
Diff. of Latitude	3 55	Sum 2)	88 45
	60		
		Mid. Lat.	44 22
In miles	235		90 00
		Co. Mid. Lat.	45 38

BY CONSTRUCTION.

Draw the line AD, and from A to B lay off the difference of Latitude 235; on B erect the Perpendicular BC, and make the Angle BAC equal to the Course 5 Points; draw the line CD, making an Angle equal to the Middle Latitude 44° 22′ with BC; then the Departure BC will measure 352, the Distance AC 423, and the difference of Longitude DC 492.



BY CALCULATION.

To find the Departure.

As Radius -	10.00000
Is to diff. of Latitude 235	2.37107
So is Tang. Course 5 Pts.	10.17511
	12.54618
	10.00000
To the Departure 351.7	2.54618

To find the Distance.

As Co.Sine of Course 5Pts.	9.74474
Is to diff. of Latitude 235	2.37107
So is Radius .	10.00000
	12.37107
	9.74474
To the Distance 423	2.62633

To find the diff. of Longitude.

As Co. Sine Mid. Lat. 44°22′	9.85423
Is to Departure 351.7	2.54617
So is Radius -	10.00000
	12.54617
	9.85423
To diff. of Long. 492	2.69194

To find the Longitude in.

Longitude left .	15° 6′ W.
Diff. of Long. 492m. or	8 12 E.
Longitude in .	6 54 W.

BY INSPECTION.

Over the Course 5 Points, and opposite half the difference of Latitude 117.5, in its column, will be found half the Departure, 175.4

and half the Distance 211; these, multiplied by 2, give the whole Departure 350.8, and the Distance 422.

The Co. Mid. Lat. 45° 38′ being taken as a Course between 45° and 46°, give opposite half the Departure 175.4, in the Distance columns, 248 and 244; half the sum of these, viz. 246, will be half the difference of Longitude, which, multiplied by 2, gives the difference of Longitude 492.

BY THE COMMON GUNTER.

Extend from the Complement of the Course 3 Points to the Course 5 Points on the line of Sine Rhumbs; that extent will reach from the difference of Latitude 235 to the Departure 351.7 on the line of Numbers.

Extend from the Complement of the Course 3 Points to 8 Points on the line of Sine Rhumbs; that extent will reach from the difference of Latitude 235 to the Distance 423 on the line of Numbers.

Extend from the Co. Mid. Lat. 45° 38′ to 90° on the line of Sines; that extent will reach from the Departure 351.7 to the difference of Longitude 492 on the line of Numbers.

BY THE SLIDING GUNTER.

Set the difference of Latitude 235 on the sliding line of Numbers, to the Complement of the Course 3 Points on the line of Sine Rhumbs; then, opposite the Course 5 Points on the line of Sine Rhumbs, will be the Departure 351.7 on the line of Numbers, and opposite 8 Points will be the Distance 423.

Set the Co. Mid. Latitude 45° 38′ on the sliding line of Sines to 90° on the fixed line of Sines; then, opposite the Departure 351.7 on the sliding line of Numbers, will be the difference of Longitude 492 on the fixed line of Numbers.

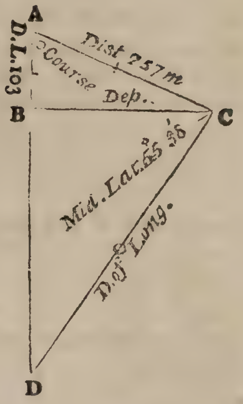
CASE V.

Both Latitudes and Distance given, to find the Course and difference of Longitude.

Example. Suppose a Ship from Latitude 56° 30′ N. has sailed South Easterly 257 miles when she arrives in Latitude 54° 47′ N. required her Course and difference of Longitude.

Latitude left	56° 30′ N.	. .	56° 30′ N.
Latitude in	54 47 N.	. .	54 47 N.
Diff. of Lat.	1 43	2)	111 17
	60		
		Mid. Lat.	55 38
In miles	103		90 00
		Co. Mid. Lat.	34 22

BY CONSTRUCTION.



Draw the line AD, and from A to B lay off the difference of Latitude 103; on B erect the Perpendicular BC; and with the Distance 257 in the Compasses, placing one foot in A, let the other cross BC in C, and draw the line AC; draw CD, making with CB an Angle equal to the Middle Latitude 55° 38′; then the Course BAC will measure 66° 22′, and the difference of Longitude CD 417.

BY CALCULATION.

To find the Course.

As the Distance	257	2.40993
Is to Radius	.	10.00000
So is diff. of Lat.	103	2.01284
		12.01284
		2.40993
To Co. Sine Course	66° 22′	9.60291

To find the diff. of Longitude.

As Co.Sine Mid. Lat.	55°38′	9.75165
Is to Tang. Course	66° 22′	10.35894
So is diff. Lat.	103	2.01284
		12.37178
		9.75165
To diff. of Longitude	417	2.62013

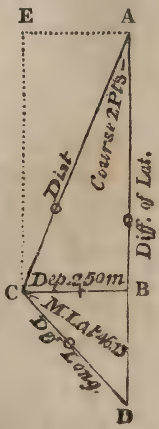
NOTE. We shall omit working this and the following Cases by Inspection and Gunter's Scales, as it is presumed the Learner sufficiently understands those methods, without further instruction.

CASE VI.

One Latitude, Course, and Departure given, to find the Distance, difference of Latitude, and difference of Longitude.

EXAMPLE. A Ship sails S S. W. from Latitude 51° 15′ N. and Longitude 9° 50′ W. until her Departure is 250 miles: required the Distance sailed, and her present Latitude and Longitude.

BY CONSTRUCTION.



Having drawn the line AD, make AE perpendicular to it, and equal to the Departure 250; through E draw EC parallel to AD, and draw AC making an Angle with AD equal to the Course 2 Points; draw CB parallel to AE, and the line CD, making an Angle with CB, equal to the Middle Latitude 46° 13′; then will the difference of Latitude AB measure 603.6, the Distance AC 653.3, and the diff. of Longitude 361.3.

To find the diff. of Latitude.

As Sine of Course	2 Pts.	9.58284
Is to Departure	250	2.39794
So is Co.Sine of Course	2 Pts	9.96562
		12.36356
		9.58284
To the diff. of Lat.	603.6	2.78072

Latitude left	.	51° 15′ N.
Diff. of Latitude 604m. or		10 4 S.
Latitude in	.	41 11 N.
Sum of Latitudes	2)	92 26
Middle Latitude	.	46 13
		90 00
Co. Mid. Latitude		43 47

To find the Distance.

As Sine of Course	2 Pts.	9.58284
Is to Departure	250	2.39794
So is Radius	.	10.00000
		12.39794
		9.58284
To the Distance 653.3		2.81510

To find the diff. of Longitude.

As Co. Sine Mid. Lat. 46°13′		9.84006
Is to Departure	250	2.39794
So is Radius	.	10.00000
		12.39794
		9.84006
To the diff. of Long. 361.3		2.55788

Longitude left	. .	9° 50′ W.
Diff. of Longitude 361 miles, or		6 1 W.
Longitude in	. .	15 51 W.

CASE VII.

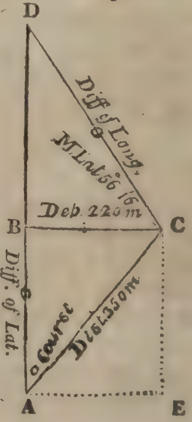
One Latitude, Distance, and Departure given, to find the Course difference of Latitude, and difference of Longitude.

EXAMPLE. A Ship from Latitude 54° N. and Longitude 33° 20′W. sails 350 miles between the North and East until she has made 220 miles of Departure: required the Course steered, and her present Latitude and Longitude.

BY CONSTRUCTION.

Draw the line AD, and make AE perpendicular to it, and equal to the Departure 220; through E draw EC parallel to AD, and, with the Distance 350 in the Compasses, set one foot in A, and let the other cross CE in C; join AC, and draw BC parallel to BAE; then the Course BAC will measure 38° 57′, and the difference of Latitude AB 272.2; hence the Latitude in will be 58° 32′, and the Mid. Lat. 56° 16′.

Make the Angle BCD equal to 56° 16′, and the difference of Longitude DC will measure 396.2.



BY CALCULATION.

To find the Course.

As the Distance	350	2 54407
Is to Radius	.	10.00000
So is Departure	220	2.34242
		12.34242
		2.54407
To Sine of Course 38° 57′		9.79835

Latitude left . .	54° 0′ N.
Diff of Lat. 272m. or	4 32 N.
Latitude in . .	58 32 N.
Sum of Latitudes	112 32
Mid. Latitude	56 16
	90 00
Co. Mid. Lat.	33 44

To find the diff. of Latitude.

As Radius	.	10.00000
Is to Distance	350	2.54407
So is Co. Sine Course 38°57′		9.89081
		12.43488
		10.00000
To the diff. of Lat. 272.2		2.43488

To find the diff. of Longitude.

As Co. Sine Mid.Lat. 56°16′		9.74455
Is to Departure	220	2.34242
So is Radius	.	10.00000
		12.34242
		9.74455
To the diff. of Long. 396.2		2.59787

Longitude left . .	33° 20′ W.
Difference of Longitude 396 miles, or .	6 36 E.
Longitude in . .	26 44 W.

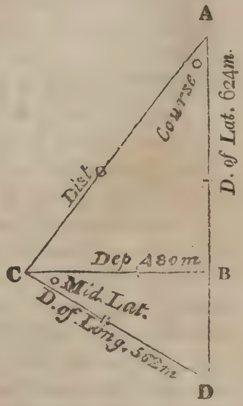
CASE VIII.

*One Latitude, Departure, and difference of Longitude given, to find the other Latitude, Course, and Distance***.*

Example. A Ship from Latitude 36° 32′ N. sails between the South and West until she has made 480 miles of Departure, and 562 miles of difference of Longitude: required her present Latitude, Course steered, and Distance run.

BY CONSTRUCTION.

Having drawn the line AD, make BC perpendicular to it, and equal to the Departure 480; draw CD equal to the difference of Longitude 562, meeting AD in D; then the Middle Latitude BCD will measure 31° 20′; hence the Latitude in is 26° 8′, and the difference of Latitude 624: now make AB equal to 624, and join AC, which will measure the Distance 787.2, and the Course CAB will be 37° 34′



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* This Case cannot be solved by Mercator's Sailing.

BY CALCULATION.

To find the Middle Latitude.

As the diff. of Long. 562	2.74974
Is to Radius .	10.00000
So is Departure 480	2.68124
	12.68124
	2.74974
To Co.Sine Mid. Lat. 31°20′	9.93150

Middle Latitude	31° 20′	
	2	
Double Mid. Lat.	62 40	
Latitude left .	36 32	N.
Latitude in .	26 8	N.
Diff. of Lat. .	10 24=624 m.	

To find the Course.

As diff. of Lat. 624 .	2.79518
Is to Radius .	10.00000
So is Departure 480	2.68124
	12.68124
	2.79518
To Tang. Course 37° 34′	9.88606

To find the Distance.

As Radius .	10.00000
Is to diff. Lat. 624 .	2.79518
So is Sec. Course 37° 34′	10.10092
	12.89610
	10.00000
To the Distance 787.2	2.89610

MERCATOR'S SAILING.

MERCATOR'S SAILING is the Art of finding on a plane surface the motion of a Ship upon any assigned Course of the Compass, which shall be true in Latitude, Longitude, and Distance sailed. This Method is derived from the projection of Mercator's Chart, in which the degrees of Longitude are every where equal, the degrees of Latitude increase towards the Poles, and the Parallels, Meridians, and Rhumb-lines, are all represented by strait lines.

Charts, in which the degrees of Longitude and Latitude are every where equal, are termed PLANE CHARTS; these, it must appear obvious from what has been said in Parallel and Middle Latitude Sailing, are constructed on erroneous principles; and it is also evident that their error must increase in proportion as the places are more remote from the Equator; but the great inconvenience of using curved lines on a plane surface, induced Mariners, notwithstanding their incorrectness, to use the Plane Charts, till Mr. Gerrard Mercator, about the year 1556, published a Chart, in which he continued the Meridians all parallel to each other, thereby extending the degrees of Longitude beyond their proper length; but, in order to compensate for this expansion of the degrees of Longitude, he enlarged the meridional lines, that is, increased the Distance between the Parallels, so that the proportion between a degree of Latitude and Longitude might be every where preserved on the Chart, at the same time that the Meridians, Parallels, and Rhumbs, would be all projected into strait lines; whence a Chart thus constructed has obtained the name of MERCATOR'S CHART; it does not, however, appear that Mercator understood the true principles of this projection, as he did not enlarge the meridional degrees in their just proportion.

In the year 1599, Mr. Edward Wright, of Caius College, Cambridge, published the true principles of Mercator's Chart, in a Work entitled, "*The Correction of certain Errors in Navigation,*" where he shewed, by a Table of *Meridional Parts,* the length of the enlarged Meridians in miles of the Equator to every minute of Latitude, and which Table he constructed according to the following principles.

It has been already demonstrated in Parallel Sailing, that the length of any portion of a parallel is to a similar portion of the Equator as the Co. Sine of the Latitude is to Radius: but the Meridians and Equator being equal on the Globe, therefore the length of any portion of a Parallel is to a similar portion of a Meridian as Co. Sine of the Latitude is to Radius, or, which is the same thing, as Radius is to the Secant of the Latitude: now, if the Meridians are made parallel to each other, the length of a degree or minute of Longitude will remain the same in every Latitude as at the Equator, by which they will be enlarged beyond their proper length in the ratio of Radius to Secant of the Latitude; therefore, the length of the meridional degrees or minutes must be likewise increased in the same proportion. Hence the length of the first minute or mile of Latitude from the Equator will be represented by the Secant 1′, (the length of a mile on the Equator being Radius) the second mile by the Secant of 2′, the third mile by the Secant of 3′, &c. consequently the length of the Meridional line to any Latitude will be equal to the sum of the Secants of all the intermediate miles between the Equator and the given Latitude.

This method of constructing Meridional Parts is not strictly accurate, because the Secants should be taken to every point of Latitude; but as the Tables of Meridional Parts are seldom carried to decimals, the error is of no consequence in any navigable Latitude; however, more accurate and expeditious methods have been since invented for the same purpose.

To find the length of the expanded Meridian between any two Parallels of Latitude, or, as it is called, the meridional difference of Latitude, the same Rules are to be observed as in finding the true or proper difference of Latitude; that is, if the Latitudes are of the same name, the difference of their corresponding Meridional Parts (taken from Table III.;) but if the Latitudes are of contrary names, the sum of those parts, will be the meridional difference of Latitude.

From the principles of Mercator's Chart it is proved, that if AB (see the figure in Case I.) represent the true or proper difference of Latitude between two places, the Angle BAC the Course, AC the true Distance, BC the Departure, as in Plane Sailing; and if we produce AB to D till it is equal to the enlarged or meridional difference of Latitude and draw DE parallel to BC; then will DE represent the difference of Longitude: now the Triangles ABC and ADE are similar, the Angle A being common to both, and the sides BC and DE parallel; therefore, as AB : BC : : AD : DE, that is, as the proper difference of Latitude is to the Departure, so is the meridional difference of Latitude to the difference of Longitude; hence, likewise, in the Triangle ADE, making AD Radius, we have, as Radius, : AD : : Tang. Angle A : ED; that is, as Radius is to mer. diff. of Latitude, so is Tangent of the Course to the difference of Longitude; Or, making AE Radius, as Co. Sine Angle A : AD : : Sine Angle A : ED; that is, as Co. Sine of the Course is to mer. diff. of Latitude, so is Sine of the Course to the diff. of Longitude: which proportions, with others derived from these Triangles, will resolve all the Cases in Mercator's Sailing.

In the following Cases, except the eighth, the same examples are introduced as in Middle Latitude Sailing, in order that a comparison may be made between the two Methods.

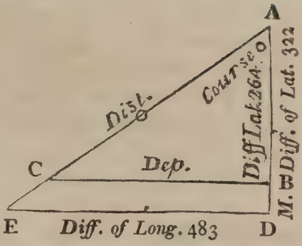
CASE I.

The Latitudes and Longitudes of two Places given, to find the Course and Distance between them.

EXAMPLE. Required the Course and Distance from Cape St. Vincent, in Latitude 37° 1′ N. and Longitude 9° 2′ W. to Funchal, in Madeira, in Latitude 32° 37 N. and Longitude 17° 5′ W.

Lat. Cape St. Vincent	37° 1′N.	Mer. Parts	2394	Long. C. St. Vinc.	9° 2′W.
Lat. Funchal .	32 37 N.	Mer. Parts	2072	Long. Funchal	17 5 W.
Diff. of Latitude	4 24	Mer. diff. Lat.	322	Diff. of Long.	8 3
	60				60
In miles .	264			In miles	483

BY CONSTRUCTION.



Draw the line AD to represent the Meridian of Cape St. Vincent, upon which lay off the meridional difference of Latitude 322; on D erect the Perpendicular DE (Prob. II. or XII. Geom.,) make it equal to the difference of Longitude 483, and draw the line AE; from A to B lay off the proper difference of Latitude 264, and through B draw BC parallel to DE; then will the Angle EAD be the Course, measuring 56° 19′ or 5 Points, and AC the Distance 476.

BY CALCULATION.

To find the Course.			To find the Distance.		
As Mer. diff. of Lat.	322	2.50786	As Radius	.	10.00000
Is to Radius	. .	10.00000	Is to prop. diff. Lat.	264	2.42160
So is diff. of Long.	483	2.68395	So is Sec. Course 56° 19′		10.25602
		12.68395			12.67762
		2.50786			10.00000
To Tang. Course 56° 19′		10.17609	To the Distance	476	2.67762

Hence the direct Course from Cape St. Vincent to Funchal is S. 56° 19′ W. or S. W. b. W. and the Distance 476 miles.

BY INSPECTION

Seek in the Tables for half the merid. diff. of Lat. 161 and half the diff. of Longitude 241.5 till they are found against each other in the Lat. and Dep. columns; the nearest to these are 161.1 and 241.1 in that page marked 5 Points at the bottom, which is the Course; over that Course, and opposite half the proper diff. of Latitude 132 in its column, is found, in the Dist. column, 238, which, multiplied by 2, gives the Distance required, 476.

BY THE COMMON GUNTER.

Extend from the mer. diff. of Lat. 322 to the diff. of Long. 483 on the line of Numbers: that extent will reach from 45° to the Course 56° 19′ on the line of Tangents.

Extend from the Complement of the Course 33° 41′ to 90° on the line of Sines; that extent will reach from the proper diff. of Lat. 264 to the Distance 476 on the line of Numbers.

BY THE SLIDING GUNTER.

Set the mer. diff. of Lat. 322 on the sliding line of Numbers, to the diff. of Long. 483 on the fixed line of Numbers; then, opposite 45° on one of the lines of Tangents will be the Course 56° 19′ on the corresponding line of Tangents.

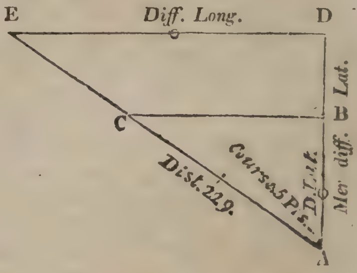
Set the Complement of the Course 33° 41′ on the sliding line of Sines to 90° on the fixed line of Sines; then, opposite the proper diff. of Lat. 264 on the sliding line of Numbers will be the Distance 476 on the fixed line of Numbers.

CASE II.

One Latitude, Course, and Distance given, to find the difference of Latitude and difference of Longitude.

Example. A Ship from Latitude 52° 6′ N. and Longitude 35° 6′ W. sails N. W. b. W. 229 miles: required her present Latitude and Longitude.

BY CONSTRUCTION.



Draw the line AD and make the Angle DAE equal to the Course 5 Points; from A to C lay off the Distance 229, and from C draw CB perpendicular to AD; then will AB measure the diff. of Latitude 127: hence the Latitude come to is 54° 13′, and the mer. diff. of Latitude 212; make AD equal to 212, and draw DE parallel to BC; then will the difference of Longitude DE measure 317.3.

BY CALCULATION.

To find the diff. of Latitude.

As Radius . .		10.00000	Lat. left	52° 6′ N.	Mer. Pts. 3675
Is to Distance	229	2.35984	Diff. of Lat.	2 7 N.	
So is Co. Sine Cou. 5 Pts.		9.74474			
			Lat. in	54 13 N.	Mer. Pts. 3887
		12.10458			
		10.00000	Mer. diff. of Lat.		212
To the diff. of Lat. 127.2		2.10458			

To find the diff. of Longitude.

As Radius . .	10.00000	Longitude left . .	35° 6′ W.
Is to Mer. diff. Lat. 212	2.32634	Diff. of Long. 317 m. or	5 17 W.
So is Tang. Course 5 Pts.	10.17511		
		Longitude in .	40 23 W.
	12.50145		
	10.00000		
To diff. of Long. 317.3	2.50145		

BY INSPECTION.

Over the Course 5 Points, and opposite the Distance 229, is the difference of Latitude 127.2; hence the Latitude come to is 54° 13′, and the mer. diff. of Lat. 212; then, over the Course 5 Points, and opposite half the mer. diff. of Lat. 106, in a Lat. column, will be found 158.8 in a Dep. column which, multiplied by 2, gives the diff. of Longitude 317.6.

BY THE COMMON GUNTER.

Extend from 8 Points to the Complement of the Course 3 Points on the line of Sine Rhumbs; that extent will reach from the Distance 229 to the the difference of Latitude 127.2 on the line of Numbers.

Extend from 4 Points to the Course 5 Points on the line of Tangent Rhumbs; that extent will reach from the mer. diff. of Latitude 212 to the diff. of Longitude 317.3.

BY THE SLIDING GUNTER.

Set the Distance 229 on the sliding line of Numbers to 8 Points on the fixed line of Sine Rhumbs; then, opposite the Complement of the Course 3 Points will be the diff. of Latitude 127.2.

Set the mer. diff. of Latitude 212 on the sliding line of Numbers to the Complement of the Course 3 Points on the fixed line of Sine Rhumbs; then, opposite the Course 5 Points will be the difference of Longitude 317.3.

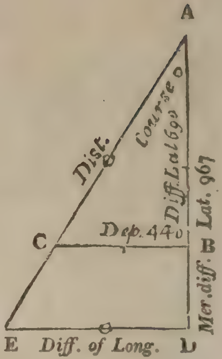
CASE III.

Both Latitudes and Departure given, to find the Course, Distance, and Difference of Longitude.

Example. A Ship from Latitude 49° 57′ N. and Longitude 5° 11′ W. sails between the South and West until she arrives in Latitude 38° 27′ N. and finds she has made 440 miles of Departure: required the Course she has steered, the Distance run, and the Longitude she is in.

Latitude left .	49° 57′ N.	Mer. Parts	3470
Latitude in .	38 27 N.	Mer. Parts	2503
Diff. of Latitude	11 30	Mer. diff. Lat.	967
	60		
Miles	690		

BY CONSTRUCTION.



Having drawn the line AD, make AB equal to the proper diff. of Latitude 690; on B erect the Perpendicular BC, and make it equal to the Departure 440; also make AD equal to the meridional diff. of Latitude 967, and draw DE parallel to BC; through A and C draw the line AE, meeting DE in E; then will the Angle CAB be the Course 32° 31′, AC the Distance 818.5, and DE the difference of Longitude 616.5.

BY CALCULATION.

To find the Course.

As diff. of Lat.	690 .	2.83885
Is to Radius	.	10.00000
So is Departure	440	2.64345
		12.64345
		2.83885
To Tang. Course 32° 31′		9.80460

To find the Distance.

As Sine of Course	32° 31′	9.73042
Is to Departure	440	2.64345
So is Radius	.	10.00000
		12.64345
		9.73042
To the Distance 818.5		2.91303

To find the diff. of Longitude*

As Radius . .	10.00000
Is to Mer. diff. Lat. 967	2.98543
So is Tang. Course 32° 31	9.80447
	12.78990
	10.00000
To diff. of Long. 616.5	2.78990

Longitude left . .		5° 11′ W.
Diff. of Long. 616 m. or	10	16 W.
Longitude in	15	27 W.

BY INSPECTION.

One fourth the difference of Latitude and Departure, that is, 172.5 and 110, are found to correspond nearly under 32° and 33°, the Departure opposite the difference of Latitude 172.5 being too little under 32° and too much under 33°; therefore the Course is about 32½ degrees, and the distances answering to these are 203 and 206: their sum 409, divided by 2, gives one fourth the Distance 204.5, which, multiplied by 4, gives the whole Distance 818.

One fourth the mer. diff. of Latitude 241.7 in one of the Lat. columns of the page marked with the Course 32° at the top, gives in the Dep. column 151.0, and the same with the Course 33° at the top gives 156.9; the sum of these is 307.9, which, divided by 2, gives 153.9; this multiplied by 4, gives the difference of Longitude 615.6.

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* Or, since the Triangles ABC and ADE are similar, the difference of Longitude may be found independent of the Course; for as AB : BC : : AD : DE; that is, as the proper diff. of Lat. is to the Dep, so is the mer diff. of Lat. to the diff. of Longitude.

BY THE COMMON GUNTER.

Extend from the difference of Latitude 690 to the Departure 440 on the line of Numbers; that extent will reach from 45° to the Course 32° 31′ on the line of Tangents.

Extend from the Course 32° 31′ to 90° on the line of Sines; that extent will reach from the Departure 440 to the Distance 818.5 on the line of Numbers.

Extend from 45° to the Course 32° 31′ on the line of Tangents; that extent will reach from the meridional diff. of Latitude 967 to the difference of Longitude 616.5 on the line of Numbers.

BY THE SLIDING GUNTER.

Set the difference of Latitude 690 on the sliding line of Numbers to the Departure 440 on the fixed line of Numbers; then, opposite 45° on the sliding line of Tangents will be the Course 32° 31′ on the fixed line of Tangents.

Set the Course 32° 31′ on the sliding line of Sines to 90° on the fixed line of Sines; then, opposite the Departure 440 on the sliding line of Numbers will be the Distance 818.5 on the fixed line of Numbers.

Set 45° on the sliding line of Tangents to the Course 32° 31′ on the fixed line of Tangents; then, opposite the mer. diff. of Latitude 967 on the sliding line of Numbers, will be the difference of Longitude 616.5 on the fixed line of Numbers.

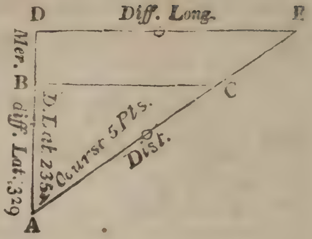
CASE IV.

Both Latitudes and Course given, to find the Distance, and difference of Longitude.

Example. A Ship from Latitude 42° 25′ N. and Longitude 15° 6′ W. sails N. E. b. E. for several days, and then finds by observation that she is in Latitude 46° 20′ N.: required the Distance she has sailed and her present Longitude.

Latitude left .	42° 25′ N.	Mer. Parts	2815
Latitude in by Obs.	46 20 N.	Mer. Parts	3144
Diff. of Latitude.	3 55	Mer. diff. Lat.	329
	60		
In miles	235		

BY CONSTRUCTION.



Draw the line AD, and from A to B lay off the diff of Lat. 235; on B erect the perpendicular BC, and make the Angle BAC equal to the Course 5 Points; lay off the mer. diff. of Lat. 329 from A to D, and through D draw DE parallel to BC; then the Distance AC will measure 423, and the diff. of Longitude DE 492.

BY CALCULATION.

To find the Distance.		To find the diff. of Longitude.	
As Co.Sine of Course 5Pts.	9.74474	As Radius -	10.00000
Is to diff. of Latitude 235	2.37107	Is to mer. diff. of Lat. 329	2.51720
So is Radius .	10.00000	So is Tang. Course 5 Pts.	10.17511
	12.37107		12.69231
	9.74474		10.00000
To the Distance 423	2.62633	To diff. of Long. 492.4	2.69231

Longitude left . .	15° 6′ W.
Difference of Longitude 492 miles, or	8 12 E.
Longitude in . .	6 54 W.

BY INSPECTION.

Over the Course 5 Points, and opposite half the difference of Latitude 117.5, in its column, will be found half the Distance 211 in its proper column; this, multiplied by 2, gives the whole Distance 422.

Over the same Course, and opposite half the mer. diff. of Latitude 164.5 found in a Latitude column, stands 246.1 in the corresponding Dep. column; which, multiplied by 2, gives the diff. Longitude 492.2.

BY THE COMMON GUNTER.

Extend from the Complement of the Course 3 Points to 8 Points on the line of Sine Rhumbs; that extent will reach from the difference of Latitude 235 to the Distance 423 on the line of Numbers.

Extend from 4 Points to the Course 5 Points on the line of Tangent Rhumbs; that extent will reach from the mer. diff. of Lat. 329, to the diff. of Longitude 492.4 on the line of Numbers.

BY THE SLIDING GUNTER.

Set the diff. of Latitude 235 on the line of Numbers, to the Complement of the Course 3 Points on the line of Sine Rhumbs; then, opposite 8 Points on the line of Sine Rhumbs, will be the Distance 423 on the line of Numbers.

Set the mer. diff. of Lat. 329 on the line of Numbers to the Complement of the Course 3 Points on the line of Sine Rhumbs; then, opposite the Course 5 Points on the line of Sine Rhumbs will be the difference of Longitude 492 on the line of Numbers.

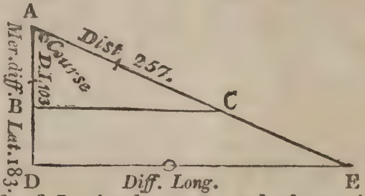
CASE V.

Both Latitudes and Distance given, to find the Course and difference of Longitude.

Example. Suppose a Ship from Latitude 56° 30′ N. has sailed South Easterly 257 miles when she arrives at Latitude 54° 47′ N: required her Course steered, and difference of Longitude.

Latitude left .	56° 30′ N.		Mer. Parts	4128
Latitude in .	54 47 N.		Mer. Parts	3945
Diff. of Latitude	1 43		Mer. diff. Lat.	183
	60			
Miles	103			

BY CONSTRUCTION.



Draw the line AD, and from A to B lay off the diff. of Latitude 103; on B erect the Perpendicular BC, and with the Distance 257 in the Compasses set one foot in A, and with the other describe an Arch cutting BC in C, and draw the line AC; from A to D lay off the mer. diff. of Latitude 183, and through D draw DE parallel to BC, meeting AC produced in E; then the Course BAC will measure 66° 22′, and the diff. of Longitude DE 418.

BY CALCULATION.

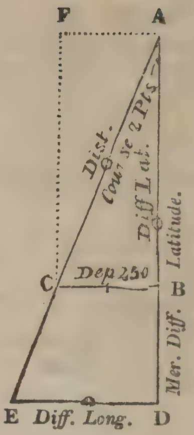
To find the Course.			To find the diff. of Longitude.		
As the Distance	257	2.40993	As Co. Sine Course 66° 22′		9.60302
Is to Radius	.	10.00000	Is to mer. diff. Lat.	183	2.26245
So is diff. of Lat.	103	2.01284	So is Sine Course 66° 22′		9.96196
		12.01284			12.22441
		2.40993			9.60302
To Co. Sine Course 66° 22′		9.60291	To diff. of Longitude 418.2		2.62139

CASE VI.

One Latitude, Course, and Departure given, to find the Distance, difference of Latitude, and difference of Longitude.

Example. A Ship sails S. S. W. from Latitude 51° 15′ N. and Longitude 9° 50′ W. until her Departure is 250 miles: required the Distance sailed, and her present Latitude and Longitude.

BY CONSTRUCTION.



Draw AD, and make AF perpendicular to it, on which lay off from A to F, the Dep. 250; through F draw FC parallel to AD, and draw AC making an Angle with AD equal to the Course 2 Points, meeting FC in C, through which draw CB parallel to FA; then will the Distance AC measure 653, and the diff. of Latitude AB 604; hence the Latitude in is 41° 11′, and the mer. diff. of Lat. 877; from A to D lay off 877, and draw DE parallel to BC or FA, meeting AC produced in E; then will the diff. of Longitude DE measure 363.

BY CALCULATION.

To find the dift. of Latitude.

As Sine of Course	2 Pts.	9.58284
Is to Departure	250	2.39794
So is Co.Sine of Course	2 Pts	9.96562
		12.36356
		9.58284
To the diff. of Lat.	603.6	2.78072

Lat. left	51° 15′ N.	Mer. Pts.	3593
Diff. Lat.	10 4 S.		
Lat. in	41 11 N.	Mer. Pts.	2716
	Mer. diff. Lat.		877

Long. left	9° 50′ W.
Diff. Long.	6 3 W.
Long in	15 53 W.

To find the Distance.

As Sine of Course	2 Pts.	9.58284
Is to Departure	250	2.39794
So is Radius	.	10.00000
		12.39794
		9.58284
To the Distance	653.3	2.81510

To find the diff. of Longitude.

As Co. Sine of Cou.	2 Pts.	9.96562
Is to mer. diff. Lat.	877	2.94300
So is Sine Course	2 Pts.	9.58284
		12.52584
		9.96562
To the diff. of Long.	363.3	2.56022

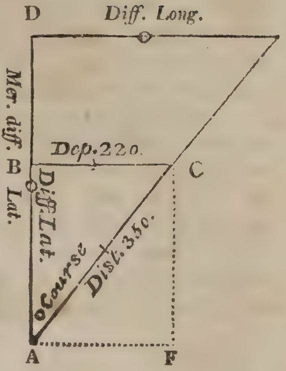
CASE VII.

One Latitude, Distance, and Departure given, to find the Course, difference of Latitude, and difference of Longitude.

EXAMPLE. A Ship from Latitude 54° N. and Longitude 33° 20′W. sails 350 miles between the North and East until she has made 220 miles of Departure: required the Course steered, and her present Latitude and Longitude.

BY CONSTRUCTION.

Draw AD and AF perpendicular to it, which make equal to the Departure 220; through F draw FC parallel to AD, and, with the Distance 350 in the Compasses, set one foot in A, and with the other draw an Arch cutting FC in C; join AC, and draw BC parallel to AF; then the Course BAC will measure 38° 57′, and the difference of Lat. AB 272.2; hence the Latitude in is 58° 32′, and mer. diff. of Latitude 490; from A to D lay off 490, and through D draw DE parallel to AF or BC, meeting AC produced in E; then the diff. of Longitude DE will measure 396.



BY CALCULATION.

To find the Course.

As the Distance	350	2.54407
Is to Radius	.	10.00000
So is Departure	220	2.34242
		12.34242
		2.54407
To Sine of Course 38° 57′		9.79835

Lat. left	54° 0′ N.	Mer. Pts.	3865
Diff. Lat.	4 32 N.		
Lat. in	58 32 N.	Mer. Pts.	4355
		Mer. diff. Lat.	490

Longitude left	.	33° 20′ W.
Diff. of Longitude 396, or		6 36 E.
Longitude in	.	26 44 W.

To find the diff. of Latitude.

As Radius	.	10.00000
Is to Distance	350	2.54407
So is Co. Sine Course	38° 57′	9.89081
		12.43488
		10.00000
To the diff. of Lat.	272.2	2.43488

To find the diff. of Longitude.

As Co. Sine Course	38° 57′	9.89081
Is to mer. diff. Lat.	490	2.69020
So is Sine Course	38° 57′	9.79840
		12.48860
		9.89081
To diff. of Long.	396.1	2.59779

CASE VIII.

*One Latitude, Course, and difference of Longitude given, to find the Distance and difference of Latitude.**

EXAMPLE. A Ship from Latitude 34° 29′ N. sails S. 41° W. till her difference of Longitude is 680 miles: required her present Latitude and Distance sailed.

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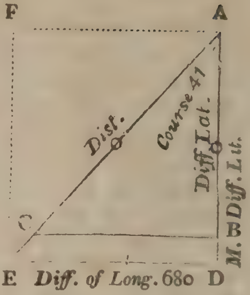
* This Case cannot be solved by Middle Latitude Sailing.

BY CONSTRUCTION.

Draw AD and make AF perpendicular to it, and equal to the difference of Longitude 680; draw FE parallel to AD, AE making an Angle with AD equal to the Course 41°, meeting FE in E, and ED parallel to FA; then AD will be the mer. diff. of Latitude equal to 782; which subtracted from the mer. parts of the Latitude left gives the mer. parts of the Latitude in; hence the Latitude in is 23° 6′, and the diff. of Latitude 683. Make AB equal to 683, and draw BC parallel to ED; then AC will be the Distance measuring 905.



BY CALCULATION.

To find the mer. diff. of Latitude.

As Radius . .		10.00000	Lat. left	34° 29′ N.	Mer. Pts. 2207
Is to diff. of Long.	680	2.83251			Mer. diff. Lat. 782
So is Co. Tang. Course	41°	10.06084			
			Lat. in	23 6 N.	Mer. Pts. 1425
		12.89335			
		10.00000	Diff. Lat.	11 23	
				60	
To mer. diff. Lat.	782.3	2.89335			
			Miles	683	

To find the Distance.

As Co. Sine Course	41°	9.87778
Is to diff. of Lat.	683	2.83442
So is Radius	.	10.00000
		12.83442
		9.87778
To Distance .	905	2.95664

QUESTIONS FOR EXERCISE.

1. Required the Course and Distance from the Cape of Good Hope, in Latitude 34° 24′ S. and Longitude 18° 32′ E. to the Island of St. Helena, in Latitude 15° 55′ S. and Longitude 5° 44′ W.

Ans^{r}. By Middle Latitude Sailing the Course is N. 49° 55′ W. and Distance 1722 miles.

By Mercator's Sailing the Course is N 49° 46′ W. and Distance 1717 miles.

2. A Ship from Lat. 29° 47′ N. and Long. 24° 36′ W. sails S. S. W. ¾ W. 320 leagues: required her present Latitude and Longitude.

Ans^{r}. By Middle Latitude Sailing, her Latitude in is 16° 4′ N. and Longitude in 33° 32′ W.

By Mercator's Sailing her Latitude in is 16° 4′ N. and Longitude in 33° 33′ W.

3. Suppose a Ship from Latitude 0° 10′ N. and Long 19° 32′ W. sails between the South and East, till she has made 415 miles of Departure, and is by observation in 2° 19′ S.: required her Course steered, Distance run, and Longitude in.

Ansr. By Middle Latitude, or Mercator's Sailing, her Course steered is S. 31° 4′ E. Distance run 804.3, and Long. in 12° 36′ W.

4. A Ship from Latitude 46° 35′ N. and Longitude 176° 42′ W. sails N. W. b. W. ½ W. till she arrives in Latitude 51° 18′ N.: required her Distance run, and Longitude in.

Ansr. By Middle Latitude her Distance run is 600.3 miles, and Longitude in 169° 52′ E.

By Mercator's Sailing her Distance run is 600.3, and Longitude in 169° 50′ E.

OF COMPOUND COURSES.

To find the difference of Longitude made good upon compound Courses, by Middle Latitude and Mercator's Sailing.

In the preceding Cases, both of Middle Latitude and Mercator's Sailing, we have always supposed the Ship to sail on a direct Course, but when she makes a compound Course, the several Courses are to be reduced into a single Course, as in Traverse Sailing, and then the difference of Longitude may be found either by Middle Latitude or Mercator's Sailing, as will appear by the following Example.

Suppose a Ship from Latitude 52° 36′ N. and Longitude 21° 45′ W. sails N. E. 36 miles, N. b. W. 14 miles, N. E. b. E. ½ E. 58 miles, N. b. E. 42 miles, and E. N. E. 29 miles: required her present Latitude and Longitude.

Courses.	Dist.	Diff. of Lat.		Departure.	
		N.	S.	E.	W.
N. E.	36	25·5		25·5	
N. b. W.	14	13·7			2·7
N. E. b. E. ½ E.	58	27·3		51·2	
N. b. E.	42	41·2		8·2	
E. N. E.	29	11·1		26·8	
	Diff. of Lat.	118·8		111·7	
				2·7	
			Dep.	109·0	

The difference of Latitude 118.8 and Departure 109.0, give the Course N. 42° 32′ E., and Distance 161.2 by Case VI. of Plane Sailing.

Lat. left	52° 36′ N.	Mer. Pts. 3724	Long. left		21° 45′ W.
Diff. Lat. 119, or	1 59 N.		Diff. Long. 184, or		3 4 E.
Lat. in	54 35 N.	Mer. Pts. 3925	Long in		18 41 W.
Sum of Lats. 2)	107 11	Mer. diff. Lat. 201			
Mid. Latitude	53 35				

To find the difference of Longitude.

By the Middle Latitude.			By Mercator.		
As Co. Sine Mid. Lat.	53° 35′	9.77353	As Co. Sine Course	42° 32′	9.86740
Is to Departure	109	2.03743	Is to mer. diff. Lat.	201	2.30320
So is Radius	.	10.00000	So is Sine Course	42° 32′	9.82996
		12.03743			12.13316
		9.77353			9.86740
To the diff. of Long.	183.6	2.26390	To diff. of Longitude	184.4	2.26576

BY INSPECTION.

The Co. Mid. Latitude being about 36½°, first look for 36° as a Course, and for the Departure 109 in one of the Dep. columns, against the nearest to which is 186 in a Dist. column; then look for the Departure 109 in the page with 37° at the top, opposite which stands 181 in a Dist. column: the sum of this and 186 is 367, the half of which is 183.5, the difference of Longitude by Middle Lat. Sailing: or, the Course being 42½°, look in the pages with 42° and 43° at the top for the mer. diff. of Latitude 201 in a Lat. column, against the nearest to which will be 181.3 and 187.5 in the corresponding Dep. columns; the sum of these is 368.8, half of which is 184.4, the diff. of Longitude by Mercator's Sailing.

The above Method is that generally practised at Sea in estimating the difference of Longitude made good in a day's run, being considered sufficiently exact for the Distance sailed by a Ship in that time; but when the Distances are considerable, especially in high Latitudes, it is more accurate to estimate the difference of Longitude made upon each Course and Distance, according to the following Rules.

I. *By Middle Latitude.* To the Traverse Table annex a Longitude Table divided into six columns; the first is to contain the Latitude left and the several Latitudes the Ship is in at the end of each Course and Distance, estimated by the Latitudes left and differences of Latitude in the Traverse Table; the second, the sums of each following pair of Latitudes; the third, half the sums or Middle Latitudes; the fourth, the Complements of the Middle Latitude; and the fifth and sixth columns are to contain the differences of Longitude. Having found the Co. Mid. Latitudes, with these and their corresponding Departures in the Traverse Table, find the differences of Longitude, and place them in the East or West columns, according to the name of the Departure; then the difference of the sums of these columns will be the difference of Longitude made good, of the same name with the greater.

II. *By Mercator.* To the Traverse Table annex a Longitude Table consisting of five columns; the first is to contain the Latitude left and the Latitudes of the Ship at the end of each Course and Distance; the second, the meridional parts corresponding to each Latitude; the third, the meridional differences of Latitude: and the fourth and fifth, the differences of Longitude.

Having found the meridional differences of Latitude, with these and the Courses in the Traverse Table, find the corresponding differences of Longitude, which place in the East or West columns, according as the Course is easterly or westerly; then the difference between the sums of these columns will be the difference of Longitude made good upon the whole Traverse, of the same name with the greater.

Note. When the Course is North or South there is no difference of Longitude, and when it is East or West, the difference of Longitude must be found as in Case II. of Parallel Sailing.

The differences of Longitude may be found by any of the Methods given in the Sailings, but in the following Example we have used Inspection only.

EXAMPLE.

A Ship from Hangcliff in Latitude 60° 9′ N. and Longitude 0° 56′ W. sailed as follows, viz.: N. E. b. N. 69 miles, N. N. E. 48 miles; N. b. W. ½ W. 78 miles, N. E. 108 miles; and S. E. b. E. 50 miles: required her Latitude and Longitude in.

BY MIDDLE LATITUDE.

TRAVERSE TABLE.

Courses.	Dist.	Diff. Lat.		Departure.	
		N.	S.	E.	W.
N. E. b. N.	69	57.4		38.3	
N. N. E.	48	44.4		18.4	
N. b. W. ½ W.	78	74.6			22.6
N. E.	108	76.4		76 4	
S. E. b. E.	50		27.8	41.6	
		252.8		174.7	
		27 8		22.6	
		225.0		152.1	

Course N. 34° E. and Dist. 272 miles.

LONGITUDE TABLE.

Lats.	Sums.	Mid. Lats.	Co. Mid. Lats.	Diff. Long.	
				E.	W.
60° 9′	° ′	° ′	° ′		
61 6	121 15	60 37	29 23	78	
61 50	122 56	61 28	28 32	38	
63 5	124 55	62 27	27 33		49
64 21	127 26	63 43	26 17	174	
63 53	128 14	64 7	25 53	95	
Long. left .			0° 56′W.	385	49
Diff. Long. 336, or			5 36 E.	49	
Long. in			4 40 E.	336	

BY MERCATOR.

TRAVERSE TABLE.

Course.	Dist.	Diff. Lat. N.	Diff. Lat. S.	Departure E.	Departure W.
N. E. b. N.	69	57.4		38.3	
N. N. E.	48	44.4		18.4	
N. b. W. ½ W.	78	74.6			22.6
N. E.	108	76.4		76.4	
S. E. b. E.	50		27.8	41.6	
		252.8		174.7	
		27.8		22.6	
		225.0		152.1	

Course N. 34° E. and Dist. 272 miles.

LONGITUDE TABLE.

Lats.		Mer. Parts.	Mer. D. Lats.	Diff. Long. E.	Diff. Long. W.
60°	9′	4545			
61	6	4662	117	78.3	
61	50	4754	92	38.3	
63	5	4916	162		49.1
64	21	5088	172	172.0	
63	53	5023	65	97.3	

Long. left . 0 56′W. 385.9
Diff. Long. 337, or 5° 37 E. 49.1
Long. in 4 41 E. 336.8

The Longitude of the Ship, according to the first Method, is 4° 28′ E. by Middle Latitude, and 4° 26′ by Mercator's Sailing, differing from these 12 and 15 miles; but as we have already observed, it is seldom necessary to use the latter Methods at Sea.

OBLIQUE SAILING.

OBLIQUE SAILING is the application of oblique-angled plane Triangles to various Cases at Sea; as in Coasting along Shores, approaching or leaving the Land, surveying Coasts and Harbours, &c.

In this kind of Sailing, to *set an object*, means to observe what rhumb or point of the Compass is directed to it, and the *bearing* of an Object is the rhumb on which it is seen; also the bearing of one place from another is reckoned by the name of the rhumb passing through those two places; hence the bearing of two places from each other are upon opposite points of the Compass; thus, if one place bears E. N. E. from another, the latter will bear W. S. W. from the former, being in the same line, but in opposite directions.

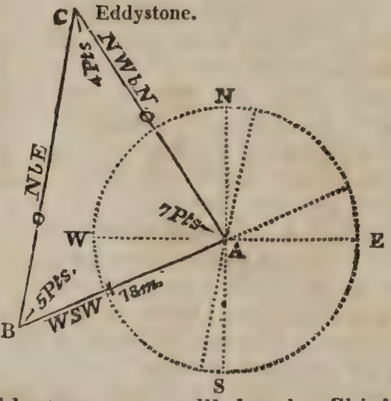
A great variety of Examples might be given in this Sailing, but as they would rather tend to exercise the Learner in Trigonometry than answer any direct purpose, we shall select those only that appear to be useful in practice.

EXAMPLE I.

Sailing down the Channel, I observed the Eddystone bear N. W. b. N.; and after sailing W. S. W. 18 miles, I found it bore from me N. b. E.: required the Distance of the Ship from the Eddystone at both stations.

BY CONSTRUCTION.

Describe the Circle N. W. S. E. to represent the Compass, and draw the Diameters W.E. and N.S. at right Angles to each other; draw the N. W. b. N., W. S. W., and N. b. E. Rhumb lines, and on the W. S. W. line lay off 18 from A to B, taken from any Scale of Equal Parts; through B draw BC parallel to the N. b. E. line, meeting the N. W. b. N. line AC in C; then will A represent the place of the Ship at her first station, B her place at the second station, and C the place of the Eddystone; AC will be the Ship's Distance from the Eddystone at the first station, measuring 21 miles, and BC the Distance at the second station, measuring 25 miles.



BY CALCULATION.

In the Triangle ABC are given the Side AB 18 miles, the Angle CAB equal to 7 Points, the measure of the arch contained between the N. W. b. N. and the W. S. W. lines; the Angle ABC equal to 5 Points, the interval between the N. b. E and the E. N. E. line, (being the opposite to the W. S. W. Rhumb), and the Angle BCA equal to 4 Points, the interval between the S. b. W. and the S. E. b. S. lines; to find the Sides AC and BC.

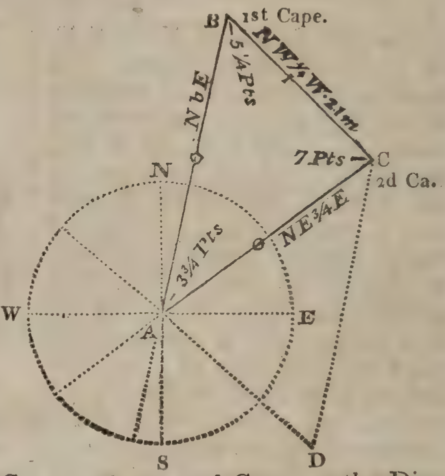
To find the Side AC.		To find the Side BC.	
As Sine of Angle C 4 Pts.	9.84949	As Sine of Angle C 4 Pts.	9.84949
Is to the Side AB 18	1.25527	Is to the Side AB 18	1.25527
So is Sine Angle B 5 Pts.	9.91985	So is Sine Angle A 7 Pts.	9.99157
	11.17512		11.24684
	9.84949		9.84949
To the Side AC 21.17	1.32563	To the Side BC 24.97	1.39735

Hence the Distance of the Eddystone from the Ship's first station is 21 miles, and from the second station 25 miles nearly.

EXAMPLE II.

Coasting along shore, I observed two Capes, the first bore N. b. E. and at the same time the second bore N. E. ¾ E.; now, by the Chart, these Capes bear from each other N. W. ¼ W.. and S. E. ¼ E. (by Compass) distant 21 miles: required my Distance from both places at that time.

BY CONSTRUCTION.



Having drawn the Compass N.W. S. E., the center of which is to represent the Ship's place, draw the N. b. E. and N. E. ¾ E. Rhumb lines AB, and AC, being the bearings of the Capes from the Ship; draw likewise the N.W. ¼W. and S. E. ¼ E. line, the bearing of the Capes from each other, on which from A to D lay off 21 miles, the Distance between the Capes; through D draw DC parallel to the N.b.E. line, and through C draw CB parallel to the N.W. ¼ W. and S. E. ¼ E. line; then B will represent the place of the first Cape, C the second Cape, AB the Distance of the first Cape from the Ship, measuring 31 miles, and AC the Distance of the second Cape, measuring 27 miles.

BY CALCULATION.

In the Triangle ABC are given the Angle BAC 3¾ Points, the Arch between the N. b. E. and N. E. ¾ E. lines; the Angle ABC 5¼ Points, the interval between the S. b. W. and S. E. ¼ E. lines; and the Angle ACB 7 Points, the interval between the N. W. ¼ W. and S. W. ¾ W. lines; and the Side BC 21 miles; to find the Sides AB and AC.

To find the Side AB.

As Sine Angle A 3¾ Pts.	9.82708
Is to Side BC 21	1.32222
So is Sine Angle C 7 Pts.	9.99157
	11.31379
	9.82708
To the Side AB 30.67	1.48671

To find the Side AC.

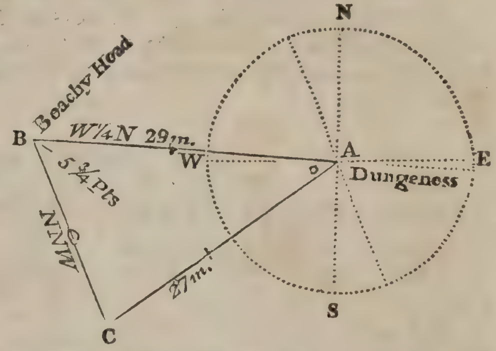
As Sine Angle A 3¾ Pts.	9.82708
Is to Side BC 21	1.32222
So is Sine Angle B 5¼ Pts.	9.93335
	11.25557
	9.82708
To the Side AC 26.82	1.42849

Hence the Distance of the Ship from the first Cape is 31 miles; and from the second Cape 27 miles nearly.

EXAMPLE III.

Being close in with Dungeness, I ran 27 miles on a direct Course to the westward, and then found Beachy Head bear N. N. W.; now the bearing of Beachy Head from Dungeness (by Compass) is W. ¼ N. and the Distance 29 miles: required the Course steered, and the Distance of the Ship from Beachy Head.

BY CONSTRUCTION.



Describe a Circle, and divide it into 4 equal parts by the Diameters, N. S. and W. E., the extremes of which will represent the cardinal Pts. of the Compass; and the center of the Circle, the place the Ship sailed from (Dungeness;) draw the W. ¼ N. line AB equal to 29 miles, then will B represent the place of Beachy Head: through B draw BC parallel to the N. N. W. line, and with the Distance run, 27 miles in the Compasses, set one foot in A, and with the other describe an Arch cutting BC in C, and draw the line BC: then will C represent the Ship's place, BC the Distance of the Ship from Beachy Head, measuring 19 miles, and the Angle SAC the Course steered from the South, measuring 53° 39′.

BY CALCULATION.

In the Triangle ABC are given the Side AB equal to 29 miles; the Side AC 27 miles; and the Angle ABC 5¾ Points, the interval between E. ¼ S. and S. S. E.; to find the Angle BAC, and the Side BC.

To find the Angle BAC.

As the Side AC	27	1.43136
Is to Sine of Angle ABC 5¾ Pts.		9.95616
So is the Side AB	29	1.46240
		11.41856
		1.43136
To Sine of Angle BCA 76° 9′*		9.98720

Angle BCA	76°	9′
Angle ABC 5¾ Pts. or	64	41
Sum	140	50
	180	00
Angle BAC	39	10

To find the Side BC.

As Sine of Angle ABC	5¾ Points	9.95616
Is to the Side AC	27	1.43136
So is Sine of Angle BAC	39° 10′	9.80043
		11.23179
		9.95616
To the Side BC	18.86	1.27563

---

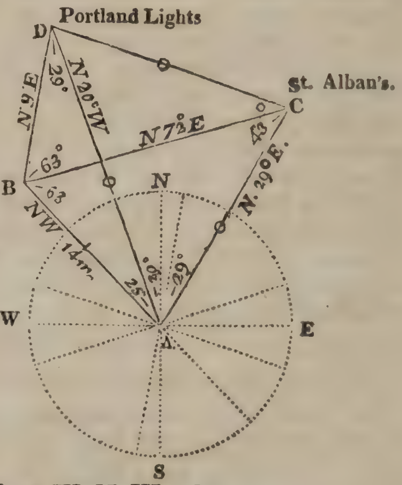
* If the above angle BCA be considered obtuse, or 103° 51′, the side BC would then be 5.938. (See Rules, page 47.)

Now the bearing of AB, which is W. ¼ N. or W. 2° 49′ N., subtracted from the Angle BAC 39° 10′, gives the bearing of AC W. 36° 21′ S.; hence the Course steered is S. 53° 39′ W. or S. W. ¾ W., and the Distance of the Ship from Beachy Head is 19 miles.

EXAMPLE IV.

At noon St. Alban's Head bore N. 29° E. and Portland Lights N. 20° W., and running N. W. at the rate of 7 knots an hour, at 2 P. M. St. Alban's Head bore N. 72° E. and Portland Lights N. 9° E.: required the bearing and distance of Portland Lights from St. Alban's Head.

BY CONSTRUCTION.



Draw the Compass as before, and let the center A represent the first station from which draw the first bearing AC, N. 29° E., and the second bearing AD, N. 20° W., also, draw the N. W. line AB equal to 14 miles, the Distance run in 2 hours; then will B represent the second station; through B draw BC parallel to N. 72° E. and BD parallel to N. 9° E., meeting the lines AC and AD in C and D, and join DC; then will C represent St. Alban's Head, D Portland Lights, and CD their Distance, measuring 18 miles, the bearing of which will be N. 70½ W. or W. N. W. ¼ W.

BY CALCULATION.

In the triangle ABC are given the Side AB 14 miles, the Angle ACB equal to 43°, the interval between S. 72° W. and S. 29° W.; and the Angle ABC equal to 63°, the interval between N. 72° E., or E. 18° N., and S. E., or E. 45° S.; to find the Side AC.

As Sine of Angle ACB	43°	9.83378
Is to the Side AB	14	1.14613
So is Sine of Angle ABC	63°	9.94988
		11.09601
		9.83378
To the Side AC	18.29	1.26223

In the Triangle ABD are given the Side AB 14 miles; the Angle ABD equal to 29°, the interval between S. 20° E. and S. 9° W.; the Angle ABD equal to 126°, the interval between N. 9° E., or E. 81° N., and S. E. or S. 45° E.; to find the Side AD.

As Sine of Angle ADB	29°	9.68557
Is to the Side AB	14m.	1.14613
So is Sine of Angle ABD	126°	9.90796
		11.05409
		9.68557
To the Side AD	23.36	1.36852

In the Triangle ACD are given the Side AC 18.29; the Side AD 23.36; and the included Angle CAD equal to 49°, the interval between N. 29° E. and N. 20° W.; to find the Angle ACD, and the Side CD.

To find the Angle ACD.

Side AD	23.36		
Side AC	18.29		
Sum	41.65		
Diff.	5.07		
		180°	
Angle CAD		49	
Sum of ADC & DCA		131	
Half		65 30′	

As sum of the Sides AC, AD,	41.65	1.61962
Is to their difference	5.07	0.70501
So is Tang. of ½ the Sum of Angles ADC, DCA	65° 30′	10.34130
		11.04631
		1.61962
To Tang. of half their diff.	14 57	9.42669
Sum gives the Ang. ACD	80 27	

To find the Side CD.

As Sine of Angle ACD	80° 27′	9.99394
Is to the Side AD	23.36	1.36847
So is Sine of Angle CAD	49°	9.87778
		11.24625
		9.99394
To the Side CD	17.88	1.25231

Now the Angle ACD 80° 27′ added to 29°, the bearing of AC from the South, gives the bearing of CD. S. 109° 27′ W., which, subtracted from 180°, leaves the bearing N. 70° 33′ W. or W.N.W. ¼ W. nearly. Hence the bearing of Portland Lights from St. Alban's Head is W. N. W. ¼ W. (by Compass) and the Distance 18 miles nearly.

NOTE. In this manner the mutual bearings and Distances of any number of Points may be ascertained; but in practice it is more expeditious, and in general sufficiently exact, to construct the Figure on a proper Scale, and then measure off the several parts.

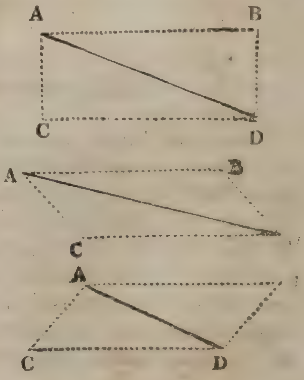
CURRENT SAILING.

CURRENT SAILING is the method of determining the true Course and Distance of a Ship when her own motion is affected and combined with that of a Current.

A CURRENT is a progressive motion of the Water, causing all floating bodies to move that way towards which the stream is directed. The *setting of a current* is that point of the Compass towards which the Water runs, and its *drift* is the rate at which it runs per hour, or in any other given time.

The most usual method of ascertaining the set and drift of an unknown Current is to take a boat, in calm weather, a small distance from the Ship, and, being provided with a half-minute glass, log, a heavy iron pot or loaded kettle and a small boat compass, to let down the pot or kettle by a rope fastened to the boat's stern, to the depth of about 100 fathoms, by which the boat will remain nearly as steady as at anchor; then the Log being hove, its bearing will be the setting of the Current, and the number of knots run out in half a minute will be its drift per hour.

The Current being known, it remains to apply its effects on a Ship's way, which will depend on the direction and velocity of both with regard to each other. If a Ship sail in the direction of the Current, it is evident that the velocity of the current must be added to that of the vessel: if her Course be directly against the Current, their difference will be the Ship's true velocity; but if a Ship's Course be oblique to the Current, her direction by the compass will be compounded with that of the Current; that is, she will proceed in the diagonal of the parallelogram formed according to the two lines of direction, and will describe or pass over that diagonal in the same time in which she would have described either of the Sides by the separate velocities. For let ABCD be a parallelogram, the diagonal of which is AD. Now if the Wind alone would drive the Ship from A to B in the same time the Current alone would drive it from A to C, then as the Wind neither helps nor hinders the Ship from coming towards the line CD, the Current will bring it there in the same time as if the Wind did not act: and as the Current neither helps or hinders the Ship from coming towards the line BD, the Wind will bring it there in the same time as if the Current did not act. Therefore the Ship must, at the end of that time, be found in both those lines; that is, in their meeting D: consequently, the Ship



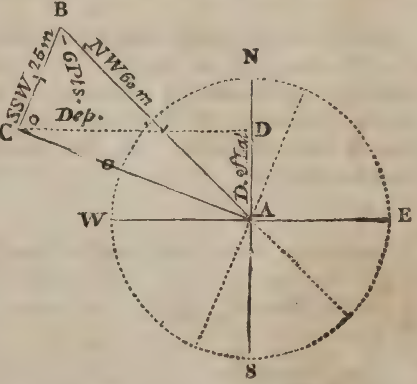
must have passed from A to D in the diagonal line AD. Hence the Ship's true Distance will be the third Side of a Triangie, whereof the other Sides are the Distance by the Log and the drift of the Current, and the true Course will be the Angle between that third Side and the Meridian.

EXAMPLE I.

A Ship sails N. W. 60 miles, in a Current that sets S. S. W. 25 miles in the same time: required her Course and Distance made good.

BY CONSTRUCTION.

Having drawn the Compass, set off 4 points from the North towards the West, and draw the N. W. line AB, which make equal to 60 miles, the Distance run by the Log; thro' B draw BC parallel to the S. S.W. and N. N. E. line, and equal to 25 miles, the set and drift of the Current; now AC being joined, will be the true Distance, measuring 55.48 miles, and the Angle NAC the true Course N. 69° 36′ W.



BY CALCULATION.

In the Triangle ABC are given the Side AB 60, the Side BC 25, and the included Angle ABC 6 points, or 67° 30′, to find the Angle BAC and the Side AC.

To find the Angle BAC.

Side AB	60		As the Sum of AB, BC .	85	1.92942
Side BC	25		Is to their difference .	35	1.54407
Sum	85		So is Tang. half Sum of Angles A and C .	56° 15′	10.17511
Diff. .	35				
		180° 00′			11.71918
Angle B		67 30			1.92942
Sum of Ang A&C		112 30	To Tang. of half the diff.	31 39	9.78976
Half .		56 15			
			Diff. gives Angle BAC	24 36	
			Angle NAB .	45 0	
			Sum gives the Ang. NAC	69 36	

To find the Side AC.

As Sine of Angle	A	24° 36′	9.61939
Is to the Side	BC	25m.	1.39794
So is Sine of Angle	B	67° 30	9.96562
			11.36356
			9.61939
To the Side AC		55.48	1.74417

Hence the Course made good NAC is N. 69° 36′ W. or W.N.W.¼W. nearly, and the Distance AC 55 miles and a half.

But the most usual and the easiest way of allowing for the effects of a Current, is to consider the setting and drift as a Course and Distance, and enter it accordingly in a Traverse Table; then the whole difference of Latitude and Departure will give the true Course and Distance. By this method the preceding Example is thus worked:

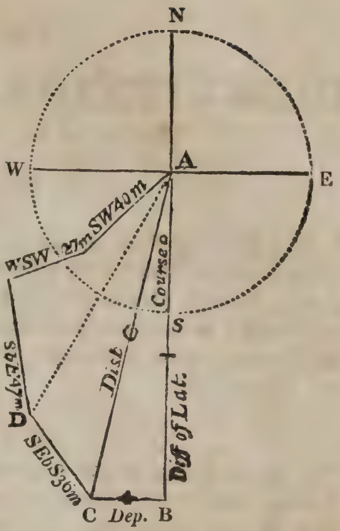
Courses.	Dist.	Diff. of Lat.		Departure.	
		N.	S.	E.	W.
N. W.	60	42·4			42 4
S.S.W. (Current.)	25		23.1		9·6
		23.1			
	Diff. of Lat.	19·3		Dep.	52·0

The difference of Latitude AD 19.3, and the Departure CD 52, give the Course DAC, N. 69° 38′ W. and the Distance AC 55.46, by Case VI. in Plane Sailing.

EXAMPLE II.

Suppose a Ship in 24 hours sails as follows: S. W. 40 miles, W. S. W. 27 miles, and S. b. E. 47 miles, being all that time in a Current setting S. E. b. S. at the rate of 1½ mile per hour: required her direct Course and Distance made good.

BY CONSTRUCTION.



Draw the Compass, and lay off the several Courses and Distances as in Traverse Sailing; then will D represent the place of the Ship by the Log: from D draw DC parallel to the S. E. b. S. line, and equal to 36 miles, for the setting and drift of the Current in 24 hours; then will C be the Ship's true place, the Angle BAC the true Course measuring 11° 50′, AC the Distance 117, AB the difference of Latitude 114.6, and BC the Departure 24 miles.

BY CALCULATION.

With the several Courses and Distances by the Log, the direct Course DAS and Distance AD may be found; then, in the Triangle ADC will be given the Angle ADC and the Sides AD, DC, to find the Angle DAC, which subtracted from DAS will give the true Course SAC, and the Side AC the true Distance. But the solution of this Triangle we shall leave to the learner, and work the question by allowing for the set and drift of the Current in the Traverse Table.

Courses.	Dist.	Diff. of Lat.		Departure.	
		N.	S.	E.	W.
S. W.	40		28·3		28·3
W. S. W.	27		10·3		24·9
S. b. E.	47		46·1	9·2	
S. E. b. S. (Current)	36		29·9	20·0	
		Diff. Lat.	114·6	29·2	53·2
					29·2
				Dep.	24·0

The difference of Latitude AB 114.6, and the Departure BC 24.0, give the true Course CAB S. 11° 50′ W. or S. b. W. and the Distance AC 117.1 miles, by Case VI. in Plane Sailing.

Many more Examples might be added, but these are all that are necessary to be understood by the practical Seaman.

DESCRIPTION AND USE OF CHARTS.

CHARTS are Marine Maps, representing the whole or part of the surface of the Water and adjoining Coasts, and exhibiting Isles, Rocks, Shoals, Banks, Depths of Water, Rhumb-lines, and whatever other particulars may serve to direct the Mariner on his voyage, or point out the dangers to be avoided: they are principally of two kinds, *Plane* and *Mercator's*.

OF PLANE CHARTS.

A Plane Chart is constructed on the supposition that the surface of the Earth is an extended plane, the meridians all parallel strait lines, and the parallels of Latitude at equal distances, and consequently that the length of the degrees of Latitude and Longitude are every where equal. But as the Earth is spherical, and the meridians meet at the poles, it is evident that Charts constructed on this principle must be erroneous; for in them the difference of Longitude, or distance between two meridians at the Equator is considered as the meridian Distance in all Latitudes; hence, the position of places laid down on these Charts, according to their Latitudes and Longitudes, will vary more or less from the truth, both in bearing and distance; however, where the Chart extends but a few degrees on either side of the Equator, the error will be trifling, because near the Equator the meridians are nearly parallel to each other; or if it begins at any considerable distance from the Equator and extends only a few degrees of Latitude, the error may, in a great measure, be obviated by making the length of the degree of Longitude equal to the Co. Sine of the mean Latitude, one degree, or 60 miles, being Radius. These Charts, from their erroneous principles being of little or no use in the practice of Navigation, have been totally rejected since the introduction of Mercator's Projection.

There is however another kind of Plane Charts, called COASTING CHARTS, which are constructed on the assumption that small portions of the Earth's surface are planes; in these neither Latitude or Longitude are, in general, taken into consideration; they are usually drawn on a large scale, for the direction of Mariners when near the land, and will not deviate much from the truth either in bearing or distance, when they do not comprehend any great extent of coast.

In these Charts places are laid down according to their bearing and distance from each other; the configuration of the coast, and other particulars, are taken from the best surveys, or such information as can be most depended upon.

OF MERCATOR'S CHARTS.

Mercator's Charts are constructed on the supposition that the Earth is spherical. In these Charts the meridians and parallels are strait lines at right Angles to each other, but the distance between the parallels are increased towards the Poles in order to compensate for the expansion of the meridian Distances, by which indeed those countries situated far from the Equator become distorted, or considerably enlarged beyond their proper size, with respect to those nearer the Equator; notwithstanding which the bearings and distances of places may be easily and accurately found by these Charts.

The following is the method of constructing a Chart on Mercator's Projection.

Having first determined the limits of the proposed Chart, that is, the number of degrees and minutes it is to contain both of Latitude and Longitude, and the degree of each it is to commence from, take out the meridional parts from Table III. corresponding to each degree of Latitude within the intended limits, and find the difference between the meridional parts of each succeeding Latitude; but if the scale of the Chart is small, the meridional parts, with their differences to every fifth or tenth degree, may be taken. Reduce the difference of the meridional parts into degrees by dividing them by 60. Draw a line near one of the margins of the paper to represent the parallel of the least Latitude, on which lay off the proposed number of degrees of Longitude, taken from a scale of equal parts, and number them at every fifth or tenth degree; from each end of this parallel draw perpendicular lines for the extreme meridians, and make them equal to the difference of the meridional parts of the extreme Latitudes, taken from the scale of Longitude or graduated parallel; join the ends of these meridians by a strait line, which will represent the other extreme parallel, and is to be divided in the same manner as the first parallel.

Take the meridional difference of Latitude between the least Latitude and the next fifth or tenth degree of Latitude, from the divided parallel, and lay it off from the first parallel on each of the extreme meridians. In like manner the meridional difference of Latitude between each successive five or ten degrees is to be taken from the graduated parallel and laid off and numbered on the meridians: but if the Chart is drawn on a large scale the meridional differences of Latitude between each degree is to be laid off. The spaces are then to be subdivided into degrees or miles.

Through each fifth or tenth degree of Latitude and Longitude draw meridians and parallels, or through each degree, if the scale will permit without crowding the Chart with a multiplicity of lines.

The principal points in the Charts are now to be laid down according to their respective Latitudes and Longitudes, and connected either by observations made on the coast, agreeable to the directions given for surveying coasts and harbours, or from the best Charts.

One or more Compasses are to be inserted in the most convenient parts of the Chart, and the Rhumb-lines extended to the coast; the variation of the Compass is to be set down in places where it is well ascertained; currents are to be denoted by darts; the best anchorages, soundings, times of high water, &c. are all to be marked in their proper places. For further particulars see Maritime Surveying.

In order to illustrate the above Rules let us take an example: Suppose, for instance, it is required to draw a Chart extending from 2 degrees of East Longitude to 30 degrees of West Longitude, and from 10 degrees to 57 degrees of North Latitude. (See Plate IV.)

Having drawn the bottom marginal line to represent the parallel of 10 degrees, divide it into 32 equal parts, the number of degrees of Longitude the Chart is to contain; and at each end erect a perpendicular line.

Take out the meridional parts corresponding to every fifth degree, and set them down with their differences in the following order:

Latitudes.		Merid. Parts.		Differences.		
10°	—	603				
15	—	910	—	307	=	5° 7′
20	—	1225	—	315	=	5 15
25	—	1550	—	325	=	5 25
30	—	1888	—	338	=	5 38
35	—	2244	—	356	=	5 56
40	—	2623	—	379	=	6 19
45	—	3030	—	407	=	6 47
50	—	3474	—	444	=	7 24
55	—	3968	—	494	=	8 14
57	—	4183	—	215	=	3 35

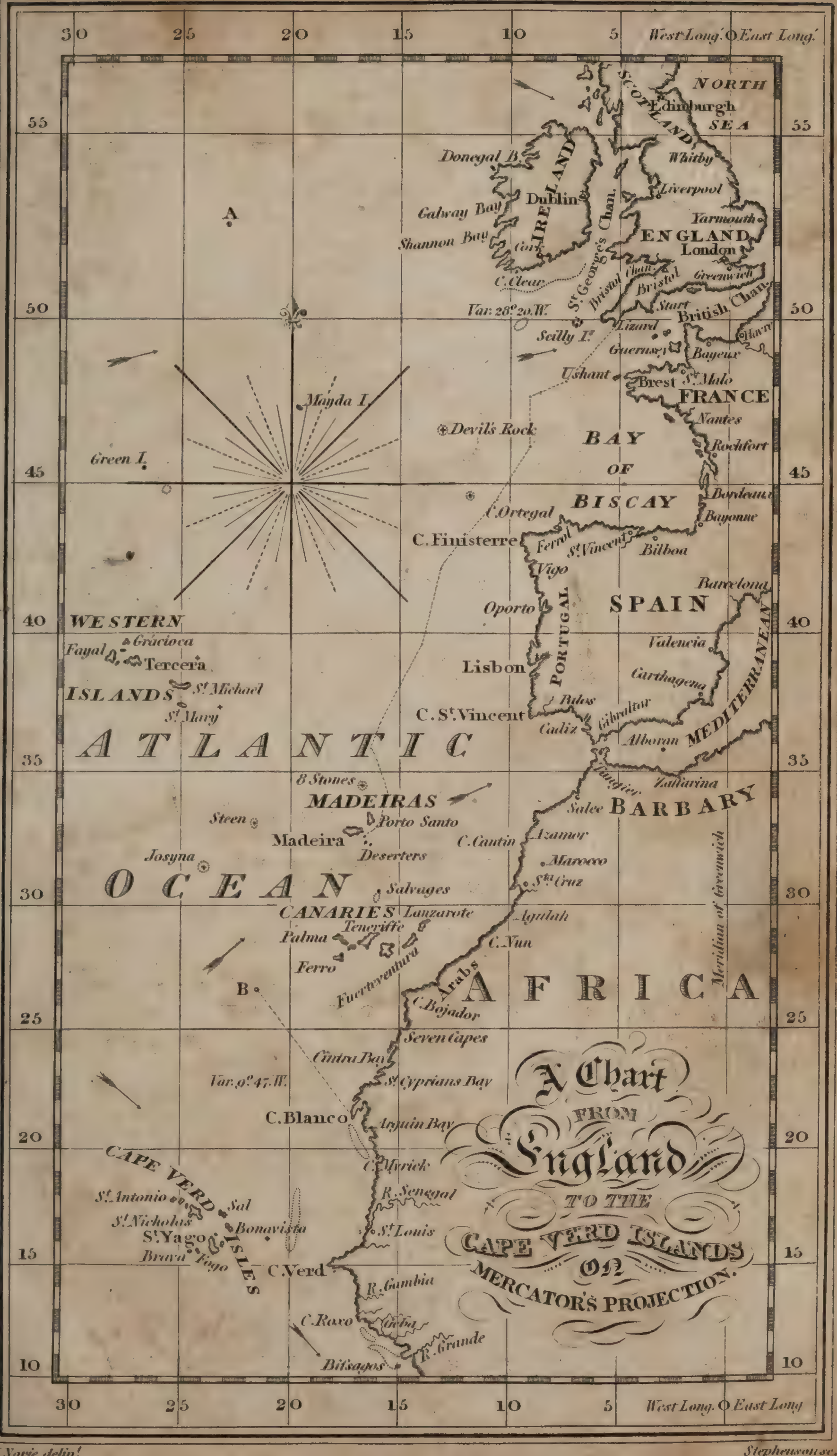
Now take the first difference 5° 7′ in the Compasses from the divided parallel, and lay it off on both meridians from 10° to 15°; from 15° to 20° lay off the next difference 5° 15′, taken from the same parallel, and so proceed to the Latitude 57°; through each of these corresponding points draw lines to represent the respective parallels of Latitude, and subdivide the extreme meridians into degrees. Divide the parallel of 57° in the same manner as that of 10°, and draw meridian lines through every fifth degree, numbering them as on the Chart.

The principal points are to be laid down agreeable to their Latitudes and Longitudes, through which the coast is to be drawn; and the various particulars are to be inserted, as Rocks, Shoals, Islands, a Compass, &c. which will be best understood by inspecting the Chart.

USE OF MERCATOR'S CHART.

To find the Latitude and Longitude of a place on the Chart.

With a pair of Compasses take the least distance between the given place and the nearest parallel of Latitude; apply that Distance, the same way, on one of the graduated meridians, one foot of the Compasses being fixed at that point where the parallel cuts the



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graduated meridian, and the other will shew the Latitude of the place.

The least distance between the given place and one of the nearest meridians being applied in the same manner to either of the graduated parallels, will point out the Longitude of the place.

For Example: The least distance between Cape St. Vincent and the parallel of 35° on the Chart being taken and applied to one of the graduated meridians from the same parallel upwards, will give its Latitude about 37 degrees N.; and the least distance between the same Cape and the meridian of 10°, being applied to either graduated parallel, towards the right from that meridian will give its Longitude 9° West.

To lay down upon the Chart any Place whose Latitude and Longitude are given.

Lay the edge of a Scale over the given Latitude, and with a pair of Compasses take from one of the divided parallels the distance between the given Longitude and the nearest meridian line; this being applied along the edge of the Scale, from that point where the Scale intersects the meridian line, the same way that the Longitude lies, will point out the place required.

Example. Suppose a Ship is in Latitude 52° 30′ N. and Longitude 23° W.: required its situation on the Chart.

Lay the edge of the Scale over Latitude 52° 30 N., and take from one of the divided parallels the Distance between the meridian of 20° and the Longitude 23°; this being laid off along the edge of the Scale, towards the left, from the meridian of 20°, will give the Ship's place at A.

In this manner a Ship's track is usually pricked off at Sea, her Latitude and Longitude being laid down every day at noon; and the Ship's places connected by pencil lines drawn between them.

To find the Course or Bearing between two Places on the Chart.

Lay the edge of a Scale over the given places, and take the least Distance between the center of one of the Compasses drawn on the Chart, and the edge of the Scale; move this extent along so that one Point of the Compass may touch the edge of the Scale, while the other is to be kept in a perpendicular position to it, with respect to the edge of the Scale; then that other point will generate an imaginary line passing through the center of the Compass on the Chart, which will shew the course or bearing.

To find the Distance between any two Places on the Chart.

1. If the given places lay under the same meridian, find their Latitudes on the Chart, and the difference or sum of these, according as

the places lay on the same or on different sides of the Equator, will give the Distance.

2. If the given places lay in the same parallel of Latitude, take half the distance between them, and placing one foot of the Compasses in the graduated meridian on their Latitude, observe what Latitudes the other foot points to both above and below; the difference between these will be their Distance.

3. But if the given places differ both in Latitude and Longitude, take the Distance between them, and apply it to either of the graduated meridians, so that one foot of the Compasses may be as much above one place as the other is below the other place; then the degrees or minutes contained between the points of the Compasses, will be the Distance required, which may be reduced to miles or leagues.

But if the places lay nearly in a parallel, and their distance is considerable, it will conduce to accuracy if the middle Latitude between the two places be found; then half their Distance being applied alternately above and below the middle Latitude, will give the Distance:

Or, a degree may be taken near the middle parallel, and the number of these degrees and parts contained between the two places being measured along the edge of the Scale, will give the Distance.

The Distance may also be found in the following manner: Find the difference of Latitude between the given places, and take it from the Equator, or one of the graduated parallels; then lay the edge of a Scale over the given places, and move or slide one point of the Compasses along the edge of the Scale, (keeping both points parallel to the meridians) until the other point just touches a parallel. Now, the distance between the place where the point of the Compasses rested, and the point of intersection of the edge of the scale and parallel, being applied to the equator, or one of the graduated parallels, will give the Distance in degrees and parts, which may be reduced to miles.

Example. Required the Course and Distance from Cape St. Vincent to the East end of the Island of Madeira.

Lay the edge of a Scale over the two places, and take the least Distance between it and the center of the Compass, then sliding one point along the edge of the Scale, the other will shew the Course to be S. W. b.W. nearly: the extent between the two places being taken with the Compasses, and applied to one of the graduated meridians, will reach from 31° to about 38° 40′, being an interval of 7° 40′; hence the Distance is 460 miles.

Or, take the difference of Latitude between the two places, which is 4° 18′, from either of the graduated parallels, and laying the edge of the Scale over the two places, move one point of the Compasses along it until the other just touches a parallel, as that of 35°, then the extent between the place where the foot of the Compasses rested, and the point where the Scale cuts the parallel of 35°, being applied to the graduated parallel, will give the Distance 7° 40, or 460 miles, as before.

The Course steered and Distance run from any given Place being known, to find the Ship's Place on the Chart.

Lay the edge of the Scale over the given place in the direction of the Ship's Course; then take the Distance run from that part of one of the graduated meridians opposite the given place and the supposed place of the Ship, which lay off from the given place along the edge of the Scale, and it will shew the place of the Ship. Or, placing the Scale as before directed, take the given Distance from one of the graduated parallels; put one foot of the Compasses in that point of a parallel that is cut by the edge of the Scale, and the other foot will reach to a certain place along the edge of the Scale: now this foot remaining in the same position, draw in the other point of the Compasses until it just touch the above parallel, without crossing it; apply this extent to the graduated parallel, and it will give the difference of Latitude: hence the Latitude in will be known, through which a parallel being drawn, that point where it intersects the edge of the Scale will be the Ship's place.

Example. Suppose a Ship sails N. W. b. N. 400 miles from Cape Blanco; required her place on the Chart.

By either of the above methods the Ship's place will be found at B, in Latitude 26° 28′ N. and in Longitude 21° 13′ W.

MARITIME SURVEYING.

NOTWITHSTANDING the great importance of accurate Surveys of the various Coasts and Harbours that are frequented by Mariners, it must be confessed that the manner of executing this branch of the Nautical Art has been but little attended to, and that the opportunities which so frequently occur to Seamen of adding to our present stock of geographical knowledge, are almost entirely neglected, or at least such incorrect observations made as can be of little service to the attainment of truth. We therefore think it proper, before we proceed to the Astronomical part of the Work, to lay down a few general directions, illustrated by proper examples, shewing how a Coast or Harbour may be easily surveyed, with such instruments as are commonly used at sea; and we shall at the same time explain the method of delineating the observations on paper.

To survey a Bay or Harbour.

Take a general view of the place, by walking or sailing round it; during this time make a rough Sketch of the Coast, carefully drawing the various projections and bendings, and noting whatever is remarkable; on the principal points and curves place Station-Staves, or strait poles, high enough to be seen at a considerable distance, and to render these more conspicuous, fasten a piece of white bunting to the top of them; if there be a tree, house, or other remarkable object at any of these places, it may serve instead of a Station-staff; these are all to be marked down on the eye-sketch, either with letters or numbers, in order to distinguish them.

Proceed now to determine the position of the stations by observations made either on shore or on the water; in the former case find a level spot of ground near the shore whereon a base line may be measured, which base line must be so situated that the whole, or the most part of the Stations, or remarkable objects, may be seen from both the extremities, and its length and direction, if possible, such that the Angle contained between it and any of the Station-staves taken from one end, may differ at least ten degrees from the same taken from the other end thereof; then set up two Station-staves, the further these are from each other, in general, the better; carefully measure their distance either by a chain, a measuring pole, or a piece of log-line divided into feet, and observe their bearing as accurately as possible by an Azimuth Compass.

If a base line of sufficient length cannot be taken in one right line, two adjoining lines and their included Angle may be measured, and the distance between their extremes found either by construction or computation, which may be considered as a base; the bearing of this line may be ascertained from that of one of the measured lines and the adjacent Angle.

When the survey cannot be taken on shore, (which, however, is always to be preferred on account of the superior accuracy with which the observations can be made,) a base-line may be laid down on the water, by mooring two buoys in the most convenient situations, and measuring, as accurately as possible, their bearing and distance from each other.

Having fixed upon a base-line, from each extremity, observe the bearing of the several remarked objects, and note them down in their proper order; or rather, with a quadrant or sextant observe the Angles formed between the base-line and lines drawn from each end to the several stations. If any of the Angles exceed the limits of the instrument, it may be measured at twice, by taken the angular distance of some intermediate object from each extreme object.

These Bearings or Angles are all to be entered on paper as they are taken, and distinguished by the letters marked on the rough Sketch.

If any of the objects are not visible from both or either end of the base-line, their positions must be ascertained by Angles taken from stations whose situations are already known; sometimes it will be necessary to measure out a new base, which is to be connected, if possible, with the first base, either by Angles taken from both extremities of the first base, or from one extremity and a Station-staff, or from two Station-staves whose positions have been previously determined.

When the survey is made by base-lines on the water, if all the principal points cannot be seen from two stations, moor as many buoys as are necessary, and observe their bearings and distances from each other, which set down in the manner of a Traverse; Bearings or Angles being then taken from any two of them whose situations have been determined, will give the positions of the places required.

Having proceeded so far on the survey, it will be proper to lay down the observations on paper; for which purpose describe a Circle with the Chord of 60°, and through its centre draw the magnetic north and south line: on this Circle lay off the bearing of the base, and draw a line parallel to it on a convenient part of the paper, to represent the position and length of the base; from each end of the base draw lines parallel to the respective observed bearings, previously laid down on the Circle; or if Angles between the base-line and the stations be observed, a Circle is to be drawn at each end of the base on which they are to be laid off, then the intersection of each pair of corresponding lines will give the position of the stations, between each of which the configuration of the Coast is to be drawn from the Sketches already made.

Now sail about the Harbour at low water, and take the soundings or depths of the sea, observing whether the ground be rocky, sandy, shelly, &c.; at the place where each sounding is taken, observe the bearings of two remarkable objects whose positions had been previously determined; hence its situation may be accurately laid down on the Chart, where the depth of water is to be denoted by small numeral figures. In like manner determine the situation of rocks, shoals, anchoring-places, &c. that may be in or near the Harbour, and mark them down accordingly. Observe the set and velocity of the tide of flood, by heaving the log while at anchor, and denote the same on the Chart by small darts. The time of high water, at new and full moon, is to be inserted in roman numeral letters; rocks are to be denoted by small crosses; sands by dotted shading; good anchoring places by a small anchor, and stopping places by a small anchor without a stock. Whilst going on with the necessary operations on the water, take particular care, on coming near the shore, to correct the outline of the Chart, by observing the inflection, creeks, &c. more minutely.

In a small sailing vessel go out to sea, and take drawings of the appearance of the land, with its bearings. Sail into the Harbour, observe the appearance of its entrance, and particularly whether there be any false resemblance of an entrance by which Ships may be deceived into danger. Remark the signs or objects, by attending to which, the Harbour may be entered with safety; more especially, where it can be done, let the Ship steer to the anchoring place, keeping two remarkable objects in one, or in a line. These leading marks are to be inserted on the draft by drawing fine double lines through the objects.

The necessary observations being all laid down on the Chart, shade the Coast on the land side with Indian-ink, and draw houses, churches, trees, &c. in their proper places; the Coast should be shaded so as to exhibit, as nearly as possible, its natural appearance, particularly shewing whether it is high, low, sandy, rocky, bad shore, &c. In a convenient place insert a Mariner's Compass, by which the situation of the Rhumbs will be shewn; this may be drawn either according to the magnetic or true north, as may be thought proper; the variation is to be marked by placing a small fleur de lis at the north point from which the Compass is not drawn. The name of the place, on what Coast or Country, the Latitude and Longitude, and whatever else may be thought necessary, are to be ascertained and inserted in the Chart.

To survey a Coast while sailing along it.

When the Ship has arrived at a convenient situation, from whence there is a tolerably extensive view of the Coast, there cast anchor, or ly-to as steady as possible; then, while the Vessel is in this stationary position, observe, with an Azimuth Compass, the bearings of the most material projections and hollows, and whatever objects are remarkable on the Coast; or rather, take the bearing of one of the most conspicuous points, and observe, with a quadrant or sextant, the angular distances contained between it and the other remarkable objects; write these down on paper, and make a rough Sketch of the Coast, on which mark the observed points, &c. with letters for the sake of reference.

Then let the Ship run in a direct line upon a known Course, measuring the distance with all imaginable care by a Log, or otherwise; during which time take soundings, and draw a more correct Sketch of the Coast, with appearances of land, &c.: when she has at length attained a proper situation from whence the same points and objects before observed may be still seen, ly-to as at the first station, and again observe the Bearings or Angles of the former objects, and likewise of others in the continuation of the Coast, which note down as before; in this manner proceed from station to station, until the survey is extended as far as may be thought proper.

The observations are to be laid down on paper, by drawing the Ship's Courses and Distances between the stations in the manner of a Traverse, and setting off the Bearings and Angles observed at each station; then the intersection of the corresponding lines will give the position of the several observed points and objects, through which the configuration of the Coast is to be drawn from the Sketches made while sailing along it.

To reduce a Draught to any Scale required.

Surveys being usually drawn upon a large scale for the sake of accuracy, it frequently becomes necessary to reduce them to a smaller when they are used in the construction of Charts, in order to adapt them to that particular scale on which the other parts of the Chart are drawn; this may be performed several ways, but the following is the easiest, and the most convenient in practice.

Divide the whole, or that part of the Draught to be copied, into small squares, by setting off any convenient number of equal divisions on the marginal lines, and through these drawing lines across the Draught with a black-lead pencil; in like manner divide that part of the paper on which the copy is to be taken, into the same number of squares. If the divisions round the margins are numbered alike on both Draughts, or if every fourth or fifth line be drawn somewhat stronger than the rest, the corresponding squares will be more readily discovered. With a pencil draw in such lines, curves, and other particulars on the copy as are found in the corresponding squares of the former Draught: when the whole is thus correctly copied, draw the lines, &c. over with a pen dipped in Indian-ink dissolved in water, and when dry rub out the pencil lines with Indian-rubber, or crumbs of stale bread.

We shall now proceed to elucidate what has been said on surveying, by the three following Examples, each of which exhibit a different method of conducting the operation.

EXAMPLE I.

Let it be required to survey the Harbour, No. 1, Plate V. by observations made on the water.

Having sailed round the Harbour, and fixed upon the several stations on the Coast, let the two buoys, A and B, be moored so that all the points or stations may be seen from both, whose bearing, from A to B, as observed by an Azimuth Compass, suppose to be N. 46° E. and their distance measured by a log, one mile[*]; then having taken the boat to the stations A and B, suppose the following bearings to have been taken.

---

[*] In a case like this where it is necessary to make the observations on the water, as it will be difficult to measure accurately the distance between the buoys, the same may be ascertained between any two of the stations on shore, which will furnish a scale for the plan, and the Bearings or Angles being taken from the buoys will shew the relative position of the stations.

From Station A.					From Station B.				
AC	=	N.	100°	E.	BC	=	N.	121°	E.
AD	=	N.	72	E.	BD	=	N.	99	E.
AE	=	N.	63	E.	BE	=	N.	73	E.
AF	=	N.	29	E.	BF	=	N.	12	E.
AG	=	N.	12	E.	BG	=	N.	36	W.
AH	=	N.	33	W.	BH	=	N.	74	W.
AI	=	N.	110	W.	BI	=	N.	122	W.

The above bearings being observed, proceed to draw the plan as follows: in a convenient part of the paper describe a Circle, with the Chord of 60°, and through the center draw a line to represent the magnetic meridian, or north and south line; on this Circle lay off the bearings as above, and through A and B draw lines parallel to them; then the intersection of these lines will give the position of the points CDEFGHI, through which draw the configuration of the Coast, according to the Sketch previously made, and insert the isles, rocks, shoals, and sand-banks, that lay within or near the Harbour, with the marks to avoid them, the proper places for anchoring, the depth of water in various parts, the variation of the Compass, and whatever other particulars may appear worthy of notice.

EXAMPLE II.

Wanting to survey a Coast whilst sailing along it: I ran from A to B, (No. 2, Plate V.,) W.S.W. 6 miles; from B to C, West 4 miles; and from C to D N.N.W. ½ W. 3½ miles; taking the following Bearings and Angles at each station:

1. From Station A.

The Bearing of	AG	=	N. 51° 0′ W.
The Angle	GAE	=	58 40
——	GAF	=	25 0
——	GAH	=	21 50

2. From Station B.

The Bearing of	BK	=	N. 33° 0′ W.
The Angle	KBL	=	17 40
——	KBI	=	28 35
——	KBH	=	56 0
——	KBG	=	60 0
——	KBF	=	69 40
——	KBE	=	80 3

3 From Station C.

The Bearing of	CK	=	N. 46° 0′ E.
The Angle	KCI	=	13 16
——	KCL	=	36 30
——	KCM	=	44 0
——	KCN	=	55 45
——	KCO	=	83 26

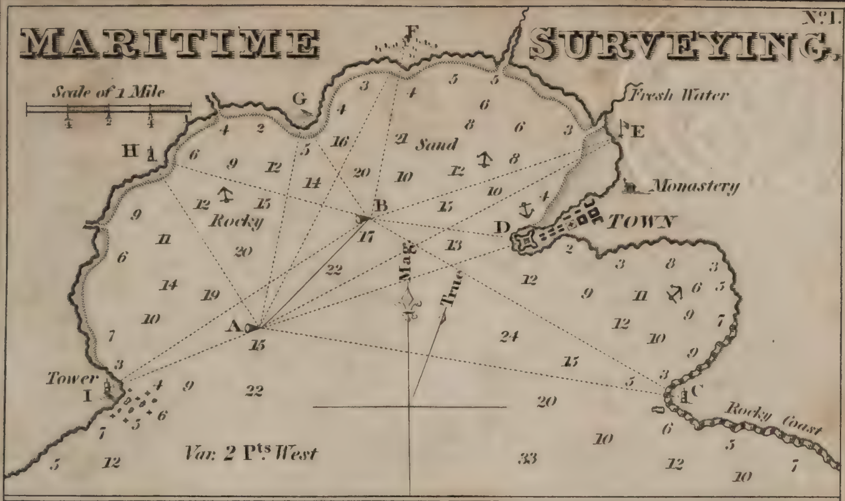
4. From Station D.

The Bearing of	DN	=	N. 20° 0′ E.
The Angle	NDO	=	67 50
——	NDM	=	22 5

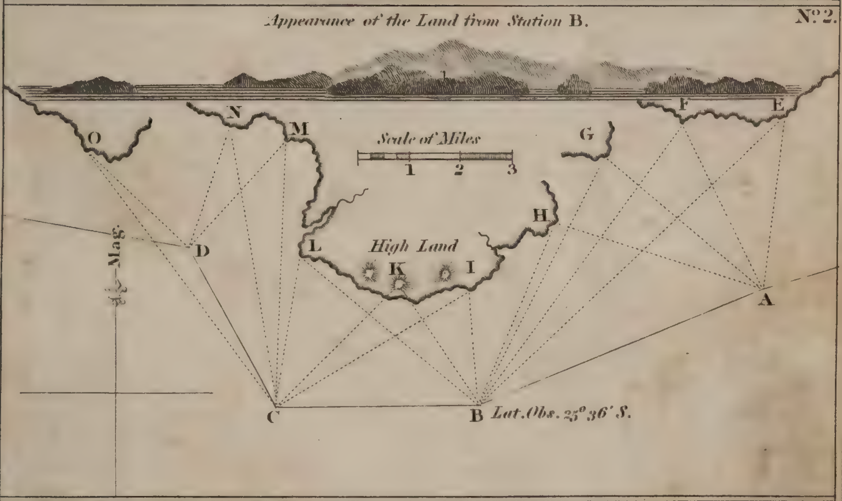
To delineate these observations on paper, first draw a Compass in a convenient part, and fix upon a point, as A, for the first station; through which draw the line AB parallel to the W.S.W. Rhumb-line, and equal to 6 miles, the distance run on that Rhumb; then will B be the second station: proceed in like manner with the second and third Courses, by which you will obtain the third and fourth stations C and D. Through A draw the line AG parallel to N. 51° W., laid off on the Compass, and make the Angles GAE, GAF, GAH, according to the above observations; in the same manner the Bearings and Angles are to be laid down from the other

MARITIME SURVEYING,

No. 1.



No. 2.



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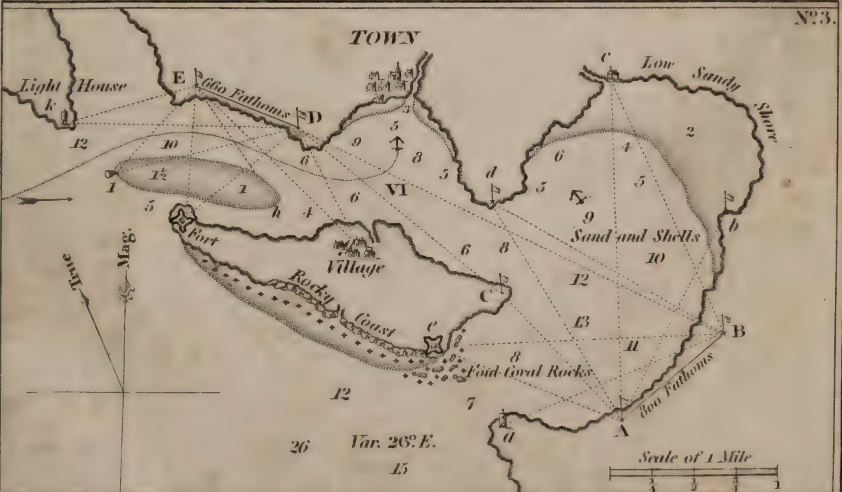

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stations; then the intersecting lines will give the points EFG, &c. through which the Coast is to be drawn agreeable to the Sketches made at the time of passing along it. The Scale of miles is to be laid down from the same equal parts that the distance run were measured by.

EXAMPLE III.

Let it be required to take an accurate survey, and from thence to make a Chart, of the Harbour and adjacent Island, No. 3, Plate V.

Sail round the Coasts to be surveyed, and fix Station-staves on the principal points where there are no remarkable objects to distinguish them: at the same time take a rough Sketch of the Harbour, on which denote the situation of the objects and stations by the letters *a*, *b*, *c*, &c.; it will likewise be advisable to take a more particular Sketch of the Coasts between each station on a separate piece of paper; seek for a proper place near the shore, on which a base-line may be measured; and, since there is no part of the Coast which commands a view of all the stations, it will be necessary to measure out two base-lines; accordingly the base-line AB is fixed upon, the ground being there level, and a considerable number of the Station-staves visible from each extremity; its length, as measured by a chain, is 800 fathoms, and its bearing from A to B, N. 48° E. From each end measure the Angles contained between the base-line and the several stations within sight, which are as follow:

From Station A.

The Angle BA*b* = 23° 35′
—— BA*c* = 52 10
—— BA*d* = 82 0
—— BAC = 94 0
—— CA*e* = 25 13
—— CA*a* = 47 30

From Station B.

The Angle AB*a* = 18° 40′
—— AB*e* = 38 0
—— ABC = 50 15
—— ABD = 66 0
—— AB*d* = 69 36
—— *d* B *c* = 36 25
—— *d* B *b* = 61 10

It will now be necessary to fix upon a place whereon another base-line may be measured, from whence the remaining stations may be seen; the most convenient spot is between D and E; let DE therefore be the second base-line, its length being 660 fathoms, and bearing from D to E, N. 72° W.; but as its southern extremity D can be seen only from one end of the first base, the Angle *d* CD is to be observed from C in order to ascertain the position of the second base with regard to the first; this Angle is found to be 44° 0′; now measure the Angles formed by lines drawn from each end of this base to the Station-staves, or other objects, which are as follow:

From Station D.

The Angle ED*k* = 21° 15′
—— ED*f* = 59 42
—— *f* D*g* = 79 25

From Station E.

The Angle DE*g* = 22° 28′
—— DE*f* = 74 0
—— *f* E *k* = 70 0

Having taken all the necessary Bearings and Angles on shore, lay them down upon paper agreeable to the preceding directions; hence the relative position of the points *a*, A, B, *b*, *c*, *d*, D, E, C, *e*, *f*, *g*, and *k*, will be obtained; which are to be connected by drawing the configuration of the Coast from the Sketches made whilst sailing round the Harbour and Island. The Chart being thus far delineated, proceed to make the requisite observations on the water. In sounding for the depths of water, a shoal is discovered in one of the entrances; now its extremes *i h*, are to be ascertained by their bearings from the stations D and E; the bearing of *i* E is N. 40° E. and of *i* D, N. 72° E.; also the bearing of *h* E is N. 40° W. and of *h* D, N. 10° E.; to lay these down on the Chart, through E and D draw lines parallel to the above bearings, which are to be previously laid off on the Compass; these will meet at *i* and *h*, and determine the extremities of the Shoal; in the same way the position of the soundings, anchoring places, rocks, &c. are to be ascertained and laid down.

The above bearings being all magnetic, and it being thought proper to draw a Compass according to the true meridian, the variation, which is 26° easterly, is to be laid off to the left of the magnetic north; hence the direction of the true meridian and the other Rhumb-lines will be obtained.

The Scale shews the length of a geographical mile, containing 1018 fathoms; therefore take 1018 from the same scale of equal parts that was used in laying down the base-lines; or, make the transverse distance of 400 on the Sector, equal to the length of the base AB; then the transverse distance of 509 will be the length of one mile. (See Use of Sector, page 34.)

The following methods of ascertaining the heights and distances of remote objects being frequently useful, particularly in the practice of surveying, we think it proper to introduce them before we dismiss the present subject.

To find the height of an accessible object.

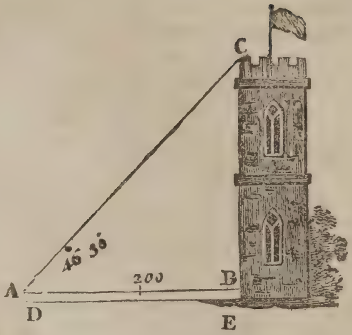
Measure the horizontal distance between the eye and the object, or the point immediately under it, and observe the angle of elevation with a quadrant; thus will be obtained the base and angle of a right-angled triangle, the perpendicular of which being found, will be the height of the object above the horizontal plane, to which add the height of the eye.

Or, by removing either towards or from the object until the angle of elevation be 45°, the horizontal distance added to the height of the eye will give the height of the object.

EXAMPLE.

From the bottom of a tower I measured 200 feet on a horizontal plane; I then took the angle of elevation and found it 46° 30′, the height of my eye being 6 feet: required the height of the tower.

In the triangle ABC are given the side AB 200 feet, and the angle BAC 46° 30′, to find the perpendicular BC.



As Radius . . .		10.00000
Is to the distance AB or DE	200	2.30103
So is tang. angle BAC	46° 30′	10.02275
To the perpendicular BC	210.7	2.32378
Height of the eye AD or BE	6	
Height of the tower CE .	216.7 feet.	

If the height of the object be known, and the angle of elevation observed, the horizontal distance of the eye may be found, for in this case there will be given the perpendicular and angles of a right-angled triangle to find the base or distance required.

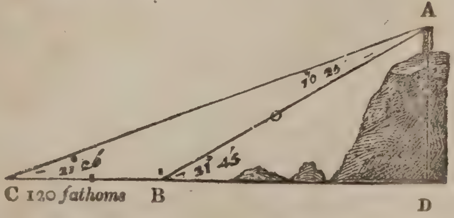
To find the height of an inaccessible object.

Measure the angle of elevation at a convenient distance from the given object; then remove in a direct line from the object, and again observe the angle of elevation, the distance between the stations being carefully measured; hence will be given one side and the angles of an oblique-angled triangle, with which find the less of the other sides. Now that side will be the hypothenuse of a right-angled triangle, the perpendicular of which being found, and the height of the eye added to it, their sum will be the height of the object.

EXAMPLE.

Wanting to know the height of a light-house above the level of the sea, and not being able to measure its horizontal distance, I took the angle of elevation and found it to be 31° 45′ and after removing from it 120 fathoms I observed the angle of elevation to be 21° 20′: required the height of the light-house.

In the triangle ABC are given the angle ACB 21° 20′; the angle CAB 10° 25′; and the side CB 120 fathoms, to find the side BA.



Angle ACB	21° 20′
Angle ABC	148 15
	169 35
	180 0
Angle CAB	10 25

As Sine Angle CAB 10° 25′	.	9.25721
Is to the Side CB 120	.	2 07918
So is Sine Angle ACB 21 20	.	9.56085
		11.64003
		9.25721
To the Side AB 241.4	.	2.38282

In the right-angled triangle ABD are given the angle ABD 31° 45′, and the hypothenuse AB 241.4, to find the perpendicular AD.

As Radius	. . .	10.00000
Is to the Hypothenuse AB 241.4	.	2.38274
So is Sine of Angle ABD 31° 45′	.	9.72116
To the Perpendicular AD 127	.	2.10390

Hence the height of the light-house is 127 fathoms, or 762 feet above the level of the sea.

In this example the height of the eye is neglected, for supposing the observations to have been made in a boat, the eye would nearly coincide with the surface of the water, and hence the omission would lead to no material error.

Shorter methods might have been given for solving the above, but as the present is worked directly by the rules of Trigonometry, it is more likely to be retained in the memory.

To find the distance of objects at sea by means of the curvature of the earth.

To the logarithm of the diameter of the earth increased by the height of the eye, add the logarithm of that height, and half the sum will be the logarithm of the distance of the visible horizon in feet; from which subtract the constant logarithm 3.783904 and the remainder will be the distance in nautical miles, to which add a tenth part of the distance on account of terrestrial refraction.

EXAMPLE.

At what distance is the visible horizon from a person whose eye is elevated 120 feet above the surface of the water?

Diameter of the earth in feet	41804400	
Height of the eye .	120	Log. 2.079181
	41804520	Log. 7.621223
		9.700404
Distance in feet .	70827.5	Log. 4.850202
		Constant Log. 3.783904
Distance in nautical miles .	11.65	. Log. 1.066298
Add one tenth part .	1.16	
Distance corrected for refrac.	12.81	

ASTRONOMY.

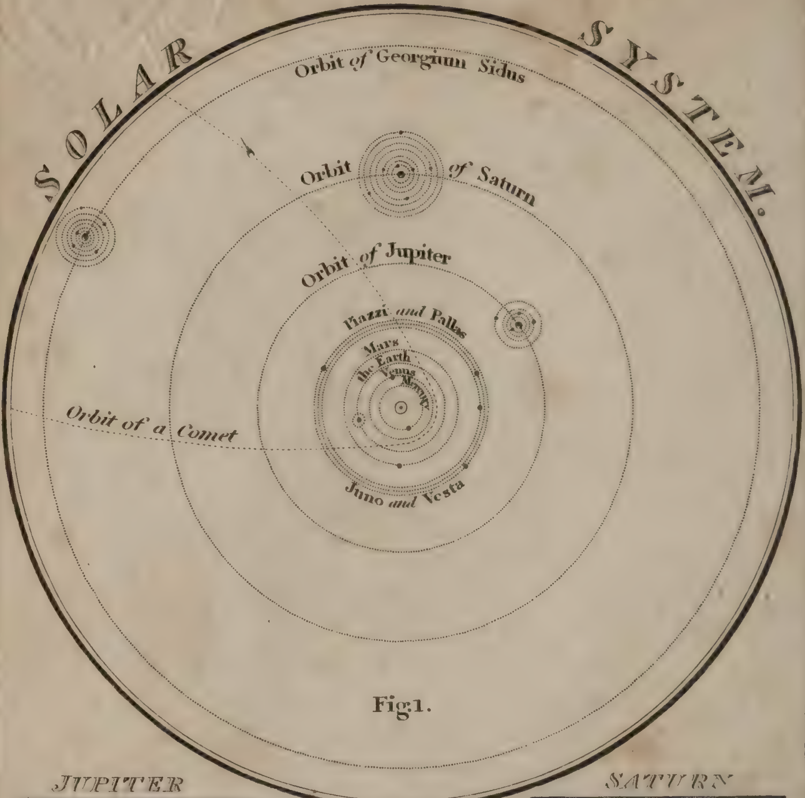
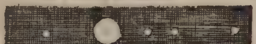
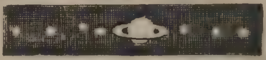


Fig. 1.



JUPITER

as he appears through a Telescope.



SATURN

as he appears through a Telescope.

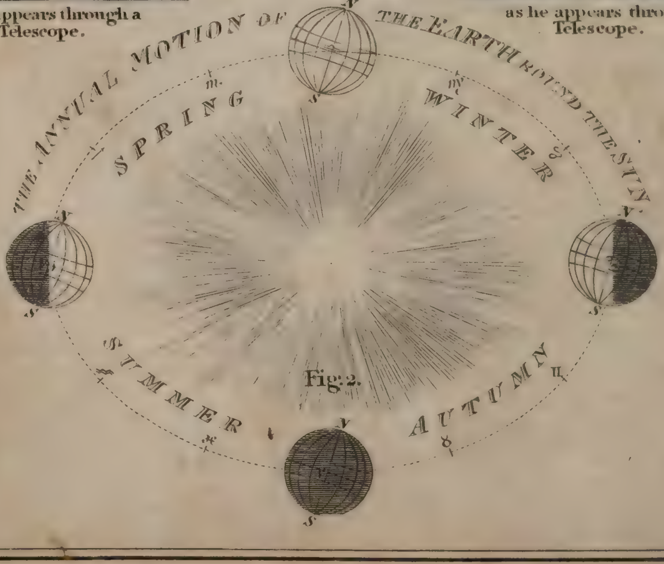


Fig. 2.

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When the height of a distant object appearing in the horizon is given, its distance from the eye is found by adding together the distances answering to each height: see explanation to Table XX.

To find the distance of an object by observing the interval between the flash and report of a gun.

Multiply 1142 (the number of feet sound travels in a second) by the number of seconds in the above interval, and the product will be the distance in feet, which, divided by 6080, will give the distance in nautical miles.

EXAMPLE.

A ship at sea was observed to fire a gun, and 24 seconds afterwards the report was heard: required the distance of the ship from the observer.

1142 multiplied by 24 gives 27408, the distance in feet, which, divided by 6080, gives 4½ miles.

ASTRONOMY

ASTRONOMY is a science which treats of the motions and distances of the heavenly bodies, and of the appearances thence arising.

A great variety of opinions have, at different times, prevailed among philosophers of the preceding ages, concerning the order and arrangement of the several parts of the universe, or of the positions of those bodies which appear in the heavens. The most eminent Astronomers of the present day suppose the universe composed of an infinite number of systems or worlds; that in every system there are certain bodies moving in free space, and revolving at different distances around a Sun, placed in or near the center of the system, and that these Suns and other bodies are the *Stars* which are seen in the heavens.

The STARS are distinguished into two kinds, viz. *fixed* and *wandering*. The fixed Stars are supposed to be Suns in the center of their systems, shining with their own light, and preserving always the same situations with respect to each other: they are usually divided according to their apparent splendor, into different classes, called *magnitudes*; the brightest being denominated Stars of the first magnitude, the next to them in brightness, of the second magnitude; and so on to those Stars that are scarcely visible to the naked eye, which are termed Stars of the sixth or seventh magnitude.

In order to assist the memory, Astronomers have divided the heavens into parcels called *constellations*; these are a number of fixed Stars, lying contiguous, which are supposed to be circumscribed by the outline of some animal, or other imaginary figure. Stars which are not included within the constellations are called *unformed Stars.* The Stars in each constellation are generally distinguished by letters of the Greek alphabet, and some of the principal have proper names; thus the Star marked α, in the constellation of Taurus, is called *Aldebaran.*

The wandering Stars are those bodies within our system which revolve round the Sun; they appear luminous by reflecting the light they receive from the Sun, and are of three kinds, namely, *primary planets*, *secondary planets*, and *comets.*

PRIMARY PLANETS are those bodies which, in revolving round the Sun, respect him only as the center of their revolution; their motions are regularly performed in tracks or paths, called ORBITS, which are nearly circular and concentric with each other.

A SECONDARY PLANET, called also a SATELLITE or MOON, is a body which, while it is carried round the Sun, also revolves round a primary planet, which it respects as its center.

COMETS are a kind of planets which move round the Sun in very eccentric orbits, and in various directions, having vast atmospheres about them, and tails of a hairy or nebulous appearance, especially when they are near the Sun.

OF THE SOLAR SYSTEM.

The SOLAR SYSTEM is that in which our earth is placed, and in which the Sun is supposed to be fixed near the center, with several bodies similar to our earth revolving round him at different distances. This hypothesis, which is the only one that can explain all the phenomena of the heavenly bodies, is said to have been first taught by Pythagoras, after whose time it remained many ages in oblivion, until it was revived, in the beginning or the sixteenth century, by Copernicus, and has since been fully established on the firm basis of demonstration by the immortal Newton.

There are eleven primary planets in our system, accompanied by at least sixteen satellites. The names of the primary planets, with their characters, reckoned in order from the Sun ☉, are as follow:—Mercury ☿, Venus ♀, Earth ⊕, Mars ♂, Vesta ⚶, Juno ⚵, Ceres ⚳, Pallas ⚴, Jupiter ♃, Saturn ♄, and Herschel, or Georgium Sidus ♅ (See Plate VI. Fig. 1.)

Mercury and Venus are called *inferior planets*, because their orbits are within the Earth's; the others are called *superior planets*, as their orbits include that of the Earth.

The primary planets, accompanied by their satellites, revolve round the Sun from west to east, in various portions of time, which are called their *periodic revolution*, or *annual motion*; the plane of their orbits all pass through the center of the Sun, but are inclined more or less to that of the Earth, crossing it in two points, called *Nodes.*

Although to an observer placed in the Sun the planets would appear to move in due order about him, from west to east; yet since the Earth is not in the center of the system, their apparent motions in the heavens are very irregular; sometimes they appear to move from west to east, and then to stand still; then they seem to move from east to west, and after standing some time, they again move from west to east, and so on continually. The motion of a planet from west to east is called the *direct* motion, or according to the order of the signs. The contrary motion from east to west is called *retrograde*, and when the planet appears to stand still, it is said to be *stationary.*

The situation of a planet in the heavens, as it would appear if seen from the Sun, is called its *heliocentric place;* and as seen from the Earth, its *geocentric place.*

The angular distance of a planet from the Sun is termed its *elongation.*

When a planet is in the same part of the heavens with the Sun, those bodies are said to be in *conjunction*; and when their angular distance is 180°, in *opposition.* The same terms are used with respect to any other two celestial bodies.

We now proceed to give a more particular description of the Sun and the planets.

The Sun, that great fountain of heat, light, and vegetation, is an immense globe of fire, placed near the centre of the orbits of all the planets; its diameter is about 890,000 English miles, and it turns round its axis in 25 days 10 hours.

Mercury is, of all the primary planets, the nearest to the Sun; his diameter is about 3224 miles, and mean distance from that luminary 37 millions of miles. His periodic revolution is performed in 87 days 23 hours.

To a spectator on the Earth this planet keeps so near the Sun that we can seldom discern him without the aid of telescopes: he appears sometimes a little before Sun-set, and at other times a little after Sun-rise.

Venus is the next planet in the order of the System, and is distinguished by her superior brilliancy; her diameter is 7687 miles, her mean distance from the Sun 68 millions of miles, and her periodic revolution is performed in 224 days 17 hours.

This planet appears to us always near the Sun, although she recedes from him almost double the distance of Mercury; when she is in that part of her orbit which is west of the Sun, she rises before him in the morning, and is called *Lucifer*, or the morning Star: and when she is in the eastern part of her orbit, she shines in the evening after he sets, and is called *Vesper*, or the evening Star.

The Earth, or planet which we inhabit, is about 7958 miles in diameter, and is about 95 millions of miles from the Sun; it performs a revolution through its orbit in 365 days 6 hours, which period is called a *year*, and revolves round its axis, from west to east, in 24 hours, which occasions the apparent diurnal motion of the Sun, and all the heavenly bodies round it, from east to west, in the same time; it is of course the cause of their rising and setting, of day and night. The axis of the Earth is inclined 23° 28′ from a perpendicular to the plane of its orbit, and keeps in a direction parallel to itself throughout its annual course, which causes the return of spring and summer, autumn and winter. Thus the diurnal motion gives us the grateful vicissitude of day and night, and the annual motion the regular succession of the seasons. (See Plate VI. Figure 2.)

The Earth is attended by a satellite called the MOON, whose diameter is 2174 miles, her mean distance from the center of the Earth about 240,000 miles; she goes round her orbit in 27 days 8 hours, revolving round her axis in the same time; but the interval between each new moon is 29½ days; the former of these periods is termed a *periodic month*, and the latter a *synodic month*, or *lunation*.

As the Moon, like the other planets, is an opake body, and borrows her light from the Sun, only one hemisphere is enlightened by the solar rays: hence she puts on various appearances, called *phases*, during her monthly course round the Earth, as her illuminated side is more or less turned towards us: when she is in the same part of the heavens as the Sun, her dark side being turned towards us, she is invisible, and this part of her period is called the *change* or time of *new Moon*; in a few days after, as she advances to the eastward of the Sun, we see a small part of her enlightened face, and she assumes a horned appearance, the *cusps* or points being turned from the Sun towards the east. When she has advanced 90° to the eastward of the Sun, we then see half her illuminated face, and she is then said to be in her *first quarter*; as she proceeds on her journey more of her enlightened side becomes visible, and she appears of an oval or gibbous form. At length, when she is in opposition to the Sun, she presents to us the whole of her enlightened face, and this is called the time of *full Moon*. In performing the other half of her revolution she wanes, and exposes less and less of her enlightened side, till she entirely disappears, and comes again in conjunction with the Sun. (See Plate VII. Figure I.)

When the Moon, at the time of conjunction, is directly between the Sun and the Earth, she will intercept a part of the Sun's rays, and thence cause an *eclipse of the Sun*; and when in opposition, the Earth is directly between her and the Sun, she will pass through the shadow of the Earth and cause an *eclipse of the Moon.* These eclipses would happen every revolution of the Moon round the Earth if their orbits were in the same plane, but the Moon's orbit is inclined to the Earth's in an angle of about 5 degrees, crossing it in two opposite points called the *Moon's nodes;* hence eclipses of the Sun and Moon can happen only when the Moon is in or near one of the nodes, she being at all other times above or below the plane of the Earth's orbit. (See Plate VII. Figure 2.)

MARS is the least bright and elegant of all the planets, being of a dull red or fiery colour, supposed to arise from the density of his atmosphere; his diameter is 4444 miles; his distance from the Sun 145 millions of miles; his periodic revolution is performed in about 687 days, and he revolves round his axis in 24 hours 40 minutes.

Mars, as well as all the other superior planets, is not subject to the same limitations in his apparent motion as Mercury or Venus, but appears sometimes near the Sun, and at other times in opposition to him.

VESTA was discovered by Dr. Olbers, of Bremen, on the 26th of March, 1807; its distance from the Sun is about 225½ millions of miles, and the length of its year, 3 years 240 days 5 hours. This planet appears like a Star of the 5th magnitude.

JUNO was discovered by Mr. Harding, of Lilienthal, in the duchy of Bremen, on the 1st of September, 1804. It appears like a Star of the 8th magnitude; is distant from the Sun about 253 millions of miles, and performs its revolution in 4 years 131 days

PIAZZI or CERES was discovered by M. Piazzi, the Astronomer Royal at Palermo, in Sicily, on the 1st of January, 1801. Its periodic revolution is 4 years 221 days 13 hours; its diameter, as computed by Dr. Herschel, is about 162 miles, and its distance from the Sun about 263 millions of miles. Ceres appears no larger than a Star of the 8th magnitude, and therefore cannot be seen with the naked eye.

PALLAS was discovered by Dr. Olbers, at Bremen, on the 28th of March, 1802; it is distant from the Sun near 263 millions of miles, and performs its revolution round it in 4 years 221 days 17 hours. Pallas appears like a Star of the 7th magnitude, and its diameter is about 110 miles.

JUPITER is the largest of all the planets, and is easily distinguished by his peculiar magnitude and light. His diameter is 89170 miles; his distance from the Sun 494 millions of miles; and he performs his periodic revolution in 4332½ days, or nearly 12 years. Jupiter completes his diurnal revolution in 9 hours and 56 minutes.

This planet is attended by four satellites, invisible to the naked eye, but through a telescope they make a beautiful appearance. In speaking of them, we distinguish them, according to their places, into the first, the second, &c. The eclipses of these are of considerable use in determining the longitude of places on the Earth. In viewing Jupiter through a telescope we find several streaks or lines over his equatorial parts, which are called his *belts;* these are supposed to arise from the swiftness of his diurnal motion, which draws his clouds and vapours into those forms.

SATURN was reckoned the most remote planet of our system before the discovery of the planet Herschel. He shines but with a pale and feeble light; his diameter is 79042 miles; his distance from the Sun 900 millions of miles, and his periodic revolution in his orbit is performed in about 29 years 167 days. Saturn revolves round his axis in 10 hours 16 minutes, and is attended by seven satellites

This planet is surrounded by a large, broad, double, and luminous ring, at a distance from it equal to the breadth of the ring. This phenomenon is quite different to all others in the planetary system, and appears intended to increase the quantity of light received from the Sun, which, on account of the vast distance of the planet, must be very small.

HERSCHEL, or as it is called, the GEORGIUM SIDUS, was discovered on March 13th, 1781, by Dr. Herschel, though there are many reasons to suppose it had been seen before, but had been considered as a fixed Star. Its diameter is 35112 miles, its distance from the Sun 1800 millions of miles, and its periodic revolution in its orbit is performed in 83 years and 52 days. This planet is attended by six satellites which were likewise discovered by Dr. Herschel.

The Astronomy of Comets is yet in its infancy; the return of one of them in the year 1758, was foretold by Dr. Halley, and it happened nearly as he predicted. He also foretold the return of another in the year 1790, but it never appeared. Probably this mistake of Dr. Halley was owing to the inaccuracy of the observations on the Comet at its former appearance; for Mr. Mechain, having collected all the observations, and calculated the orbit again, found it differ essentially from that determined by Dr. Halley.

OF THE SPHERE.

Although the celestial bodies are placed at different distances from the earth, as we have just seen; yet an observer living upon the earth, is not naturally sensible thereof, but imagines them all to be situate in one concave surface, of which the earth is the center.

Likewise, though in reality the cause of day and night is the rotation of the earth round its own axis: and of the seasons, its motion through its own orbit in a year, yet to a spectator on the earth, these appear to be effected by the motion of the Sun or heavens.

And as in most Astronomical Problems, it is the apparent or relative motions only that we have to determine; therefore for the ease of calculation, and since it amounts to the same thing whichsoever way these appearances are effected, Astronomers chuse to suppose all celestial objects placed in one concave sphere as above, and to ascribe to them all the motions which they seem to have, while the earth is considered as being at rest in the center.

In order to point out the positions of the heavenly bodies in the celestial sphere, certain points, lines, and circles are supposed to be described thereon.

Circles upon a sphere are either great or less: a *great circle* is that whose plane passes through the centre of the sphere. A *less circle* is that whose plane does not pass through the center of the sphere: hence all great circles upon a sphere divide it equally, and all less circles divide it unequally.

Those two points on the surface of a sphere which are equidistant from every part of the circumference of one of its great circles, are called the *poles* of that great circle.

If we imagine the axis of the earth produced to the celestial sphere, it is then called the *axis of the heavens*, and its extremities mark out two points in the sphere, which are called the *celestial poles*, or the *poles of the world*; one is termed the *north pole*, and the other the *south pole*. It is about these points that all the heavenly bodies appear to have a diurnal revolution.

The plane of the equator in like manner produced to the heavens, forms a circle called the *celestial equator*, or *equinoctial*, whose poles are those of the world. This circle divides the heavens into two equal parts, called the *northern* and *southern hemispheres*.

Any celestial body situated in the equinoctial will appear to describe a great circle in the heavens, and those bodies which are situated north or south of it will describe small circles; those Stars situated at either pole will appear at rest.

The circle which bounds the view of a spectator, at sea, or on an open plane, is termed the *apparent*, or *visible horizon;* a circle whose plane passes through the eye of an observer, perpendicular to a plumb-line hanging freely, is called the *sensible horizon;* and a circle parallel to this, passing through the center of the earth, is the *rational horizon;* these two circles in the sphere of the fixed Stars may be considered as one and the same*.

The *zenith* of a place is that point in the heavens immediately above the place, and the *nadir* is that point immediately under it. Hence the zenith and nadir are the poles of the rational horizon.

Azimuth, or *vertical circles*, are great circles passing through the zenith and nadir, and therefore intersect the horizon at right angles. That vertical circle which passes through the east and west points of the horizon is called the *prime vertical.*

Celestial meridians, or *circles of right ascension*, are great circles passing through the poles of the world, and cutting the equinoctial at right angles. Twenty-four of these circles, which divide the equinoctial into equal parts, each containing 15 degrees, are called *hour-circles.*

The *meridian of a place* on the celestial sphere, is that vertical circle which passes through the poles, crosses the equinoctial at right angles, and intersect the horizon at the north and south points; this circle is the terrestrial meridian of a place extended to the heavens: it divides the heavens into two hemispheres, termed the *eastern* and *western.* When the Sun is upon the meridian of a place above the horizon, it is noon; and under the horizon, it is midnight. On this circle the latitude of a place is reckoned, being always equal to the elevation of the pole above the horizon, or to the distance of the zenith from the equinoctial.

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* For the division of the horizon into points, &c. see the Mariner's Compass, opposite page 65.

The *altitude* of a celestial object is an arch of a vertical circle intercepted between the center of the object of the horizon.

The *zenith distance* is an arch of a vertical circle contained between the object and the zenith. When the object is on the meridian, its altitude, or zenith distance, are called the *meridian altitude,* or *meridian zenith distance.*

The *azimuth* is an arch of the horizon contained between the azimuth, or vertical circle, passing through the center of the object, and the meridian of the place.

The *amplitude* is an arch of the horizon contained between the center of the object when rising or setting, and the east or west points of the horizon.

The *ecliptic* is that great circle in the heavens which the Sun appears to describe in the course of a year, and is the orbit of the earth extended to the celestial sphere. It is inclined to the equinoctial in an angle of 23° 28′, called the *obliquity of the ecliptic,* and cuts it in two points diametrically opposite, called the *equinoctial points.* Those two points of the ecliptic, 90 degrees distant from the equinoctial points, are called the *solstitial points.*

The ecliptic is divided into 12 equal parts called *signs,* each containing 30 degrees: these are thus marked and named.

1. Aries ♈
2. Taurus ♉
3. Gemini ♊
4. Cancer ♋
5. Leo ♌
6. Virgo ♍
7. Libra ♎
8. Scorpio ♏
9. Sagittarius ♐
10. Capricornus ♑
11. Aquarius ♒
12. Pisces ♓

The first six signs being on the north side of the equinoctial, are termed *northern signs,* and the last six on the south side, are called *southern signs.*

The two points of the ecliptic which coincide with the equinoctial are, the beginning of Aries and Libra; the former of these is called the *vernal equinox,* and the latter the *autumnal equinox.*

The two solstitial points are situated at the beginning of Cancer and Capricorn, and are called the *summer* and *winter solstices.*

That great circle which passes through the equinoctial points and the poles of the earth, is called the *equinoctial colure*; and that great circle which passes through the solstitial points and the poles of the earth, is called the *solstitial colure.*

The Sun enters the beginning of Aries about the 21st of March; he then moves forward in the ecliptic and advances towards the north pole till he enters Cancer, which happens about the 22d of June;

then, continuing his motion according to the order of the signs, he apparently recedes from the north pole, and about the 23d of September enters Libra; still advancing in the ecliptic he gets nearer to the south pole till he enters Capricorn about the 22d of December, after which returning to the northward through the last three signs, he again enters Aries, and thus completes his annual course.

The *zodiac* is a space in the heavens extending about 8 degrees on each side of the ecliptic, like a belt or girdle, within which all the planets appear to perform their revolutions.

Circles of longitude in the celestial sphere, are great circles passing through the poles of the ecliptic, and therefore cut the ecliptic at right angles.

The *right ascension* of a celestial body is an arch of the equinoctial, contained between the first point of Aries and that point of the equinoctial which is cut by a meridian passing through the object.

The *ascensional difference* is an arch of the equinoctial, intercepted between the Sun or Star's meridian and that point of the equinoctial that rises with the object.

The *oblique ascension*, or *descension*, is the sum or difference of the right ascension and ascensional difference.

The *declination* of an object is an arch of a meridian contained between the equinoctial and the center of the object. It is called north or south declination, according as the object is on the north or south side of the equinoctial.

The *polar distance* is an arch of the meridian contained between the center of the object and either pole of the equinoctial.

The *latitude* of any object in the heavens is an arch of a circle of celestial longitude intercepted between the object and the ecliptic, and is called north or south, according as the object is north or south of the ecliptic.

The *longitude* of a celestial body is an arch of the ecliptic intercepted between the first point of Aries and a circle of longitude passing through the center of the object.

The *tropics* are two lesser circles parallel to the equinoctial, at 23° 28′ distance from it, touching the ecliptic at the solstitial points; the northern tropic touches the ecliptic at the beginning of Cancer, and is thence called the *tropic of Cancer;* the southern tropic, touching the ecliptic at the beginning of Capricorn, is therefore called the *tropic of Capricorn.*

The *polar circles* are two lesser circles, 23° 28′ distant from the poles of the equinoctial: that about the north pole is called the *arctic circle*, and the other the *antarctic circle.*

In order to illustrate the preceding definitions, let the circle ZHNO (Plate VII. Figure 3.) represent the celestial meridian, Z the zenith, and N the nadir, of a place at A; *ho* the sensible horizon of the place, which may be considered as coinciding with HIO, the rational horizon, the north and south points being O and H, and the east and west points at I; and ZBN an azimuth, or vertical circle, cutting the horizon in B; likewise let the line P *p* be the celestial axis whose pole P is elevated above the rational horizon equal to the latitude of the place. Now if V be considered as the place of a Star in the heavens, VB will be its altitude; VZ its zenith distance, HB its azimuth from the south, or BO from the north. If the Star be supposed to rise or set at F, the arch FI will be its amplitude from the east or west, and if the Star be at G, on the meridian, GH will be its meridian altitude, and GZ its meridian zenith distance.

Again, let P *p* represent the celestial axis as before; the circle ZHNO, the solstitial colure; EQ the equinoctial, of which P *p* are the poles; PD *p* a circle of right ascension; ♋♑, the ecliptic; R *r* its poles; RLR a circle of longitude, ♋♋ the tropic of Cancer, ♑♑ the tropic of Capricorn; RM the arctic Circle; and *rm* the antarctic Circle. Then if V be the place of a Star, VD will be its declination; VP or V*p* its polar distance; LV its latitude; and IL its longitude.

THE DIAMETER OF THE SUN, MOON, &C.

The apparent diameter of the Sun, Moon, &c. is the angle under which they appear to an observer situated on the Earth; the quantity of which depends upon the real magnitude of the object, and its distance from the observer. Thus, let AB (Plate VII. Figure 4,) represent the real diameter of a distant object, the eye being at C; then the angle ACB is its apparent diameter: now if the eye be removed further from the object, as to D, its apparent diameter will be the angle ADB, which is evidently less than the angle ACB; likewise if the real diameter be increased to E its apparent diameter will likewise increase, for the angle EDB is greater than the angle ADB.

The Sun's apparent semidiameter is set down in page III. of each month in the Nautical Almanac, for every seven days: but its mean semidiameter, which is 16′, is used in common practice, as it never deviates half a minute from that quantity. The Moon's semidiameter varies considerably during his monthly revolution round the Earth, and is set down for every 12th hour in page VII. of each month in the Nautical Almanac; the apparent semidiameter there given is the angle under which it would be seen when in the horizon, or from the center of the Earth; but since the Moon is nearer the observer, by a semidiameter of the Earth, when in the zenith than when in the horizon, and as this difference bears a sensible proportion to the Moon's distance from the Earth's center*, the semidiameter given in the Almanac is to be increased by a quantity, called the augmentation, depending on its altitude, which is contained in Table VII.

The distance of the Sun from the Earth being immense when compared with the Earth's semidiameter, the augmentation of the

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* The Moon is about 60 semidiameters of the Earth distant from the Earth's center.

Sun's apparent semidiameter is therefore insensible. The apparent semidiameter of a planet is so small that it is seldom noticed in calculations. The fixed Stars have no sensible apparent magnitude even when viewed through the most powerful telescopes.

DEPRESSION OF THE HORIZON.

The *depression*, or, as it is generally called, the *dip* of the horizon, is the angle contained between the sensible and apparent horizons, the angular point being the eye of the observer. Now as the altitudes of all celestial bodies observed at sea are measured from the apparent horizon which is below the sensible by a quantity depending on the height of the eye, these altitudes are greater when taken by a fore observation, and less when observed by a back observation, than they should be, by a quantity equal to the angle contained between the two horizons. Thus, let BAC represent part of the surface of the Earth, and AE the height of the observer's eye: then FEG will represent the sensible, and EH the apparent horizons, and therefore the angle FEH will be the depression, or dip, of the apparent below the sensible horizon. Let M be an object whose altitude is to be observed by bringing its image in contact with the apparent horizon; then will the angle MEH be the observed altitude which is greater than the angle MEF, the altitude from the sensible horizon, by the angle FEH. In the back observation the observed altitude is MEL, to which the angle HEF, equal to GEK, must be added to obtain the altitude above the sensible horizon FE.

The dip of the horizon is affected by terrestrial refraction, which, according to Dr. Maskelyne, amounts to $\frac{1}{10}$ the whole angle, but several Astronomers differ in opinion respecting the quantity. In Table V. of this work, which contains the dip answering to different heights of the observer, $\frac{1}{10}$ is allowed on the whole angle.

REFRACTION.

The rays of light which proceed from a celestial body, on entering the atmosphere in an oblique direction, are bent out of their rectilinear course, and incline more and more towards the center of the Earth as they pass deeper into the atmosphere, and hence enter the eye of an observer in a different direction from that of the object, and make it appear higher than its real place. The difference between the real and apparent places of the heavenly bodies, as affected by the passage of the rays of light through the atmosphere, is called the *refraction* of the object. Let ABC represent the surface of the Earth, on which the observer stands at A, and DEF the surrounding atmosphere: now the rays of light which proceed from an object at Z in the zenith falling perpendicularly on the atmosphere, are not refracted thereby, but continue in the same direction till they reach the eye of the observer. But if the rays proceed from a body not in the zenith, as at R, they fall on the atmosphere obliquely, and are bent or refracted into a curve inclining towards the Earth's center at T; and as the observer perceives objects in the direction that the rays proceeding from it enter the eye, he therefore imagines the body R to be at *r*; the difference of these places, or the arch R*r*, is the refraction of the object in altitude. Thus also if the rays from a Star at S pass on to the eye by a curve-line DA, the observer judges that Star to be in the direction of the side of this curve terminating at the eye, that is, he conceives it to be at *s*, in the direction *s*A touching the curve at the point A, where it enters the eye.

The more obliquely the rays enter the atmosphere, the more they will be bent out of their rectilinear course, and hence the greater the refraction; the quantity of refraction likewise increases with the density of the atmosphere.

From what has been said, it follows that an object at the zenith is not subject to refraction, but that as the distance from the zenith increases, the refraction becomes perceptible, and is proportionably greater, as the body observed is further from the zenith until it reaches the horizon where the refraction is greatest. Also, that by the effect of refraction the heavenly bodies appear more elevated above the horizon, than they really are, and therefore the refraction is to be subtracted from the apparent altitude of an object; in consequence of this, it likewise happens that the Sun, Stars, &c. may be actually below the horizon when they appear above it; and hence they appear to rise sooner and set later than they would otherwise do.

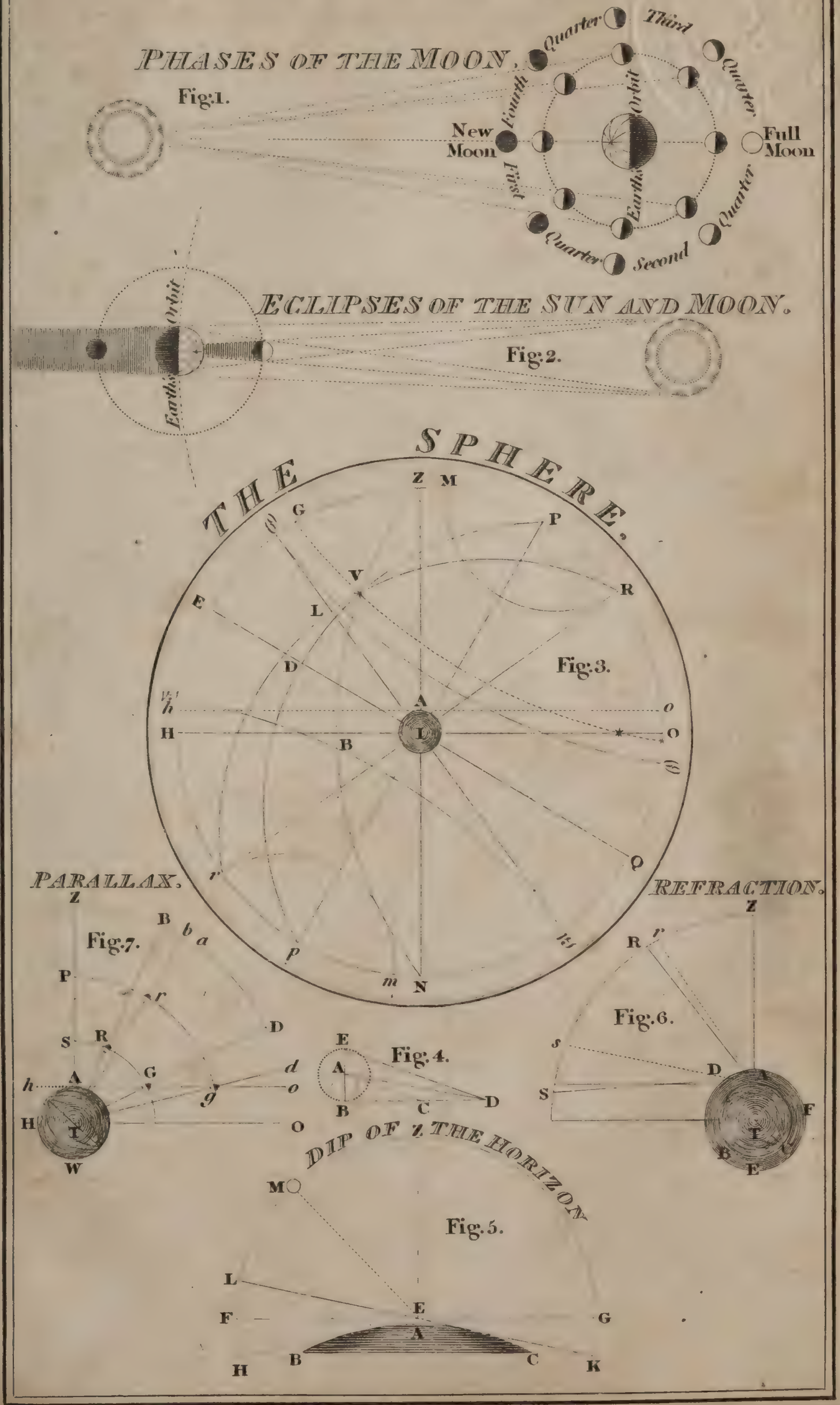
PARALLAX.

We have already observed that the sensible and rational horizons may be considered as coinciding when extended to the sphere of the heavens. This assumption will lead us to no sensible error with respect to the Stars, which are at such an immense distance from us that the earth, in comparison, is as it were, but a mere point; but, with respect, to the Sun, Moon, and Planets, the earth's semidiameter must be taken into consideration in deducing our conclusions from observations made upon those bodies.

The situation of a celestial body, when viewed from the surface of the earth is called its *apparent place*, and that part of the heavens where it would be seen if observed at the same time from the center of the earth, is called its *true place*. The difference between the true and apparent places is termed the *parallax* of the object.

In order to illustrate the nature of parallax, let AHW (Plate VII. Figure 7,) represent the earth, A the place of an observer on its surface whose sensible horizon is *ho*, rational horizon HO, and zenith at Z; also let SG be part of a vertical circle whose radius is the distance of the moon from the earth's center, P*g* part of a vertical circle whose radius is the distance of a planet from the

ASTRONOMY.



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earth's center, and ZO a vertical circle in the sphere of the Stars. Now to a spectator at A, if the moon appear in R its apparent place in the heavens will be at *a*, but if viewed from the center T its true place will be at the point B; the difference of these places, measured by the arch *a* B is its *parallax in altitude.*

But if the Moon be in the sensible horizon at G its apparent place will be at *o*, and its true place at D; the arch *o* D is called its *horizontal parallax.* Moreover, if *g* be the place of a planet in the horizon, the arch *o d* will be its horizontal parallax, and if its place be at *r*, *a b* will be its parallax in altitude.

The parallax of an object is greatest at the horizon, and gradually diminishes as the body rises above the horizon until it comes to the zenith, where the parallax vanishes. Thus *o* D and *o d*, the horizontal parallaxes of G and *g*, are greater than *a* B or *a b*, the parallaxes of R and *r* and the objects at S or P seen from A or T, will appear in the same place Z, or the zenith. The parallaxes of different objects are less or greater, as those objects are more or less distant from the earth. Thus the parallax *o* D of the Moon G is greater than the parallax *o d* of the planet *g*. It is likewise evident from the figure, that the altitude of an object seen from the earth's surface is less than it would be if seen from the center; hence the parallax is to be added to the apparent altitude, in order to obtain the true altitude.

The Moon's parallax is greater than that of the other heavenly bodies, owing to its being nearer the earth; at the horizon it varies from about 61′ 32″ to 53′ 32″, and is set down in page VII. of each month in the Nautical Almanac. The Sun's mean horizontal parallax is 8¾″; that of the planets is more or less according to their distance from us in the different parts of their orbits.

WINDS.

THE air, or atmosphere which encompasses our terraqueous globe, and extends several miles above its surface, is by its elasticity, capable of being expanded, or of spreading itself so as to fill up a larger space than it before occupied, and of being condensed, or compressed, into a less space: the principal causes in producing these effects are heat and cold, the former rarefying or expanding, and the latter condensing or compressing the air; when, therefore, any portion of it becomes heated, the cooler or denser air from the neighbouring parts will acquire a motion towards the thinner, in order to restore the equilibrium, and thereby occasion those currents of air which are called *Winds.*

Although various causes may contribute to produce this inequality, in the density of the atmosphere, yet the most general and permanent is the influence of the Sun's rays, by which the air in the regions about the equator being heated to a greater degree, and consequently more rarified than that which is nearer to either poles, the more ponderous or dense air will have a motion from the north and south, in order to preserve the equilibrium; but as the Sun is continually shifting to the westward, that part towards which the air tends, by reason of the rarefaction, is with him carried westward, and consequently the tendency of the whole body of air is that way; hence a general easterly wind is formed, which being impressed upon all the air of a vast ocean, the parts impel one another, and so keep moving till the next return of the Sun, by which so much of the motion as was lost is again restored, and thus the easterly wind is made perpetual: the combination of these two currents of air acting at the same time will produce a north-easterly wind in the northern hemisphere, and a south-easterly wind in the southern hemisphere.

If the whole surface of the globe were sea, these winds would constantly blow quite round the world without interruption; but as water is of a more even temperature than land, the latter will sometimes be hotter and sometimes cooler than the former, rarefying or condensing to a greater degree the air immediately above, whereby the air will be put in motion, the denser towards the lighter, in order to restore the equilibrium: hence when a considerable body of land intervenes, particularly in the tropical regions, new points of rarefaction and condensation take place, sufficiently powerful to counteract the former more remote, and therefore more feeble cause: for it is to be observed, that the atmosphere derives a greater portion of its heat, near the surface, from its communication with land and water, than from the direct influence of the Sun.

Partial and temporary winds are likewise frequently produced by thunder storms, or other electrical phenomena. The rays of the Sun are also sometimes obstructed by clouds, or mists in particular places, and one part of the world, or even of a particular country will consequently be less heated than another; in that case there will always be a current of air from the cold to the warm region. Besides this the falling of rain, or other circumstances, produce occasional alterations in the temperature of the air, and whenever these take place in any country they must be attended with wind.

In those parts of the Atlantic and Pacific Oceans which are remote from the influence of the land, between the limits of about 28 or 30 degrees of north and south latitude, there is a constant easterly wind, the cause of which we have already assigned in the preceding observations. On the north side of the equator the wind blows from between the north and the east, and on the south side from between the south and the east, inclining more to the north and south as they are further from the equator: these winds are denominated the N. E. and S. E. *trade winds*.

But we are not to conclude that the above limits are without exception, for both their direction and extent vary much with the season of the year: when the Sun approaches the tropic of Cancer the S. E. trade wind prevails further to the northward of the line, inclining more to the south than the east, and the N. E. trade wind more to the eastward; on the contrary, when he is in Capricorn the N. E. trade wind extends more to the southward of the equator, but inclining more to the northward, and the S. E. veers a little more to the eastward.

The S. E. trade wind generally extends as far as 5 or 6 degrees to the northward of the line, and sometimes even to 7 degrees, according to the seasons: sometimes the N. E. and S. E. trade winds almost meet each other, leaving very little space between them, and at other times there will be an interval of several degrees subject to calms, squalls, thunder, lightning, and heavy rains. It has likewise been remarked, that between the trades, the wind frequently prevails from the S. W. quarter.

The trade winds extend to higher degrees of latitude on the coasts of North and South America than on the coast of Africa; sometimes as far as 32 degrees on the North American coast, and to the same latitude south on the coast of Brazil, though they seldom exceed 28 degrees on the African side to the northward of the Cape of Good Hope.

Beyond the limits of the trade winds, in both the northern and southern hemispheres, the winds are variable, but for the most part prevailing from the westward, or W. S. W. in the northern, and from the W. N. W. in the southern latitudes; these winds often extend to the tropics, and sometimes even as far as the 20th degree of latitude.

The probable cause of the trade winds thus changing to the opposite direction appears to be, that the rarefied air within the tropical regions being pressed upon by that which is cooler or denser coming from the northward or southward, ascends to the upper part of the atmosphere, where the reflected rays of the Sun has less influence, dispersing itself in order to maintain an equilibrium, and forms a contrary current at the commencement of the temperate zone, which produces the above-mentioned winds. But the above observation must be confined to particular seasons, within certain limits, and not be considered as invariably the case, for even in the South Atlantic Ocean, in those same parallels of latitude the winds are light and variable, coming often from the S. E. and veering almost to every point of the compass.

The N. E. trade wind in the Atlantic Ocean blows in a regular fresh gale at about 100 leagues from the coast of Africa; and it is remarked.

that as ships approach nearer to the West Indies this wind generally comes nearer to the east, so as seldom to deviate more than a point either to the northward or southward.

On the coast of Brazil, the S. E. trade wind is subject to periodical shiftings, according to the respective seasons; they blow there from N. E. to E. N. E. between September and March, and from S. S. E. to E. S. E. from March to September.

On the African coast, from Cape Blanco to Sierra Leone, the winds (excepting always land breezes and storms) blow from the north, inclining rather from the westward than from the eastward. From Sierra Leone to Cape Palmas the ordinary course of the winds is from W. N. W. and beyond Cape Palmas, as far down as about 28 degrees of south latitude, from S. W. to south, inclining more to the southward or westward according to the particular situation or bearing of the shores and lands.

The reason of these dispositions of the trade winds towards the land will appear obvious from the general principles already laid down, when we consider the nature of the coasts and their situation with regard to the Sun. The vast continent of Africa, for instance, being violently heated by the Sun, especially those parts near the equator, the incumbent air will be exceedingly rarefied, and the sea being much cooler than the land, the current of air must almost constantly come from the westward to restore the equilibrium, and it is to be observed that the winds on the coast of Guinea actually acquire this direction towards the shore within 80 or 100 leagues, getting first more towards the south, then becoming full south, and afterwards shifting to the westward of the south. This part of the ocean is consequently much troubled with frequent calms, and with sudden and violent gusts of wind, known by the name of *Tornadoes*, which blow from all parts of the horizon.

In the gulf of Guinea, there is a periodical wind, called the *Harmattan*, which blows in a N. E. direction from the interior parts of Africa. The season in which it prevails is during the months of December, January, and February; it comes on indiscriminately at any hour of the day, at any time of the tide, or at any period of the Moon, and continues sometimes only a day or two, sometimes five or six days, and it has been known to last fifteen or sixteen days. There are generally three or four returns of it every season: it blows with a moderate force, but not quite so strong as the sea breeze. It has been further observed, that between the 4th and 10th degree of north latitude, and between the longitude of Cape Verd and the easternmost of the Cape Verd Island, there is a track of sea which seems to be condemned to perpetual calms, attended with terrible thunders and lightnings, accompanied with such frequent rains, that this part of the sea is called the *rains*. This appears to originate from the same cause as those we have already stated; for this tract being placed in the middle, between the westerly winds blowing on the coast and the easterly trade wind blowing to the westward of it, the tendency of the air is here indifferent to either, and therefore keeps its place, and makes a calm: and the weight of the incumbent atmosphere being diminished by the continual contrary winds blowing from hence, is the reason that the air is not able to support the vapours plentifully raised here by the heat, but lets it fall in frequent and copious showers.

All these circumstances duly considered will account for those circuitous passages which ships make in sailing from one distant port to another in the Atlantic Ocean, and for the difficulty they meet with in sailing to the southward, especially in the months of July and August, when the S. E. trade winds usually extend to 7 or 8 degrees north of the equator, and not unfrequently vary so much as to blow from the south, and even a point or two to the west of the south; for in this case every mile that is then obtained must be in the face of a constant trade wind, directly opposing the track of the ship, and by an infinite degree of trouble, and constantly plying to windward. For if, on the one hand, a ship steers W. S.W. and gets the trade wind more towards the east, she will be in danger of falling in too soon with the coast and shoals of Brazil; and if she steers E.S.E. she must fall in with the coast of Guinea, and cannot extricate herself from that situation but by running down east to the Island of St. Thomas; it is for this reason that India ships, both outward and homeward bound, pass the equator in the Atlantic between the longitudes of 18° and 23° west; by keeping this course they never fall in with the coast of America, either going to the Cape of Good Hope, or returning from it, and at the same time they avoid the calms on the coast of Africa.

These circumstances likewise point out the only possible course for ships to sail from the coast of Guinea for Europe; and that is, to steer away S.S.E. or south, and with these courses to run off the shore, while the wind becomes more and more contrary. Though ships when near the shore can lie south on this coast, yet when they get more distant they can only make good a S.E. course, and as they get further out they will only make good an E.S.E course; but they can generally make the Island of St. Thomas's, or Cape Lopez, with these directions, when they will find the winds to the eastward of the south. They then set of westerly from the coast, and run on till they come to 4 degrees south latitude, by which time they will find a constant trade wind from the S. E.

On account of these general winds, ships bound from England, or other parts of Europe, to the West India islands, or to the southern parts of the coast of North America, even as far to the northward as Virginia, consider it as most advantageous to get to the southward as soon as possible, for on their reaching the latitude of 30 degrees, or thereabouts, where they get within the influence of the trade winds, they can depend on having a steady gale from the eastward, so as to enable them to run before the wind. For the same reason all ships returning from the West Indies, or the contiguous part of the coast of North America, endeavour to run up to 30 degrees north latitude, where they first find the wind begin to be variable, so as to enable them to make to the eastward. Indeed, the most general and prevailing wind, without the northern limits of the trade wind in the Atlantic Ocean, is between the south and west, and therefore fair for bringing ships to Europe.

Again, ships bound to India from America run to the eastward in the variable winds, so as to be in the longitude of 35 or 38 degrees west when in the latitude of 30 degrees north; thence they steer south-easterly towards the Cape Verd islands, passing two or three degrees to the westward of them. Being then in the general track of the European Indiamen, they steer south-easterly to cross the equator between the longitude of 18 and 23 degrees west, where meeting the S. E. trade wind, they must brace up, and sail upon a wind till they get so far to the southward as to meet with the variable winds, when they may steer to the eastward.

Between the parallels of 28 and 40 degrees of south latitude in the Indian Ocean, as we have already observed is the case in the South Atlantic, the wind is variable, but most frequently blows between the N. W. and S.W.; it is on this account that outward bound East India ships generally run down their easting on the parallel of 36 degrees south.

From the latitude of 28 degrees south to the equator, the S. E. trade wind blows constantly without any considerable interruption in the Indian Ocean, as in the Pacific and Atlantic, between some few degrees to the eastward of Madagascar, as far nearly as the Island of Java; but in the other parts of the Indian Ocean, and in the adjoining seas, the winds divide the year into two seasons, or *monsoons**, blowing certain months in one direction, and the rest of the year in the opposite.

In the Mozambique Channel, between the Island of Madagascar and the coast of Africa, the monsoons prevail alternately; the S.W. begins in April and continues till November: the N. E. then succeeds, and continues until April; but the S.W. monsoon in this channel is the fair season, and the wind sometimes varies towards the S. E. and E. S. E. on either coast about the middle of November, where also there are in general regular land and sea breezes. The N. E. monsoon begins near the Comoro Islands and the north of Madagascar, but seldom extends beyond St. Augustine's Bay to the southward, towards which it commences only at the end of November.

To the north of the equator, in the whole extent of the seas comprized between the eastern coast of Africa and the meridian which passes through the western part of Japan, the monsoons blow from the S.W. between the middle of April and the middle of October, and from the N.E. during the rest of the year, excepting only the

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* The word monsoon is derived from the Persian word *mousum*, which signify season.

Red Sea, and the Gulf of Persia, which have particular winds; to which we might also add the Straits of Malacca, where the winds are generally shifting, and in which the monsoons do not blow for a long time.

In the Red Sea the winds blow almost nine months of the year from the southward, that is, from the end of August to the middle of May, and sometimes to the end of that month, when the wind changes to the North and N.N.W, and generally continues in that quarter to the end of August, but sometimes the land and sea breezes prevail.

In the Gulph of Persia the N. W. wind blows from the month of October to July, and about three months from the opposite quarter. These winds, however, are not so regular as those in the Red Sea, being often interrupted by fresh gales from the S.W. principally from Cape Morcandon, and sometimes by land breezes.

In the Gulf of Siam, on the Coasts of Cambodia or Camboge, Cochin China, the Gulf of Tonquin, and China, the S.W. monsoon commences near the coast in the course of the month of April, but out at sea, in those parts, it does not change till a month later. It is for this reason that on the North part of Borneo to the islands of Paragoa and Luconia, it is seldom known to blow constantly, but from the 1st to the 15th or 20th of May. As the S.W. monsoon continues only about six months, and commences near the coast, it there ceases first likewise, in the same manner, and is immediately succeeded by the N. E. monsoon. The winds in the China Seas are not so regular as in the Arabian Sea, and are frequently interrupted by violent and dangerous *tyfoons**. These tyfoons are of the same nature with the hurricanes in the West Indies, both of which appear to arise from violent and sudden changes in the upper and lower regions of the air; and it has been remarked that they happen, for the most part, about the autumnal equinox, and are always preceded by calms and hot weather.

In that part of the Indian Ocean adjoining to New Holland, between the Meridians of Sumatra and Java to the west, and New Guinea to the east, there is a regular monsoon, which sets in from the N.W. between the months of October and April; during the other months of the year the wind resumes its natural course of S. E. These winds are called the N.W. and S. E. monsoons.

The monsoons do not change suddenly from one point of the compass to the opposite; between the expiration of one, and the commencement of the other, the winds are light and variable, and sometimes calms prevail, until the regular monsoon commences, and acquires sufficient strength to blow steady.

The shifting of the N. E. and S. W. monsoons is frequently attended with violent squalls, for which reason ships between the coasts of Malabar and Africa, if bound to Bombay from the southward, never attempt to make the former coast at the breaking up of the N. E. monsoon, particularly in the month of May; hence, likewise, they avoid the Coast of Coromandel in the month of October; for it is a fact worthy of remark, that the bad weather month on the Coast of Malabar is the fine weather month on the Coast of Coromandel, and *vice versa*, although these coasts are situate on the same peninsula.

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* From the Chinese words *Ty*, great or powerful, and *Foong*, wind.

The most obvious cause of the above periodical changes in the wind appears to be the situation of the sun in the ecliptic, at the different seasons of the year; for when the Sun approaches the tropic of Cancer, the soil of Persia, Bengal, China, and the adjoining countries, become so much more heated than the sea to the southward of those countries, that the current of the general N.E. trade-wind is interrupted so as to blow at that season from the south to the north, contrary to what it would do if no land were there; but as the high mountains of Africa, during all the year, are extremely cold, the low countries of India to the eastward of it becomes hotter than Africa in Summer, and the air is naturally drawn thence to the eastward; hence it is that the wind, in those parts, blows from the S. W. between April and October, contrary to the trade winds in the Atlantic and Pacific Oceans in the same latitudes; but when the Sun retires towards the tropic of Capricorn, these northern parts become cooler, and the general trade wind assumes its natural direction from the N. E.

Upon the same principle we account for the monsoons adjoining New Holland, which we find is an immense tract of land to the S.E. of the Sunda and Molucca Islands; for when the Sun is in the tropic of Cancer, the current of air, even independent of the trade wind, will move from the S. E. to restore the equilibrium to the N. W.; on the contrary, in the months of November, December, and January, whilst the Sun is nearly vertical over a great part of New Holland, the current of air through the Sunda and Molucca Islands, will come from the N. W. to fill up the vacuum made by the rarefication, and thus occasion an alternate S. E. and N. W. monsoon.

The cause of *land* and *sea breezes*, which prevail principally between the tropics, and never extend above three or four leagues from the shore, may be explained after the same manner as the monsoons. For during the day the sea is not so much heated by the presence of the sun as the land, nor is it so much cooled during the night; therefore, when the earth begins to be violently heated in the course of the day, the cooler air from the sea will rush in towards the land, to supply the deficiency occasioned by the greater rarefaction of the air; and hence arises the sea breezes. On the other hand, the land becoming cooler than the water in the absence of the Sun, the current of air, a few hours after sunset, flows from the land to the sea, and thus produces the land breeze.

TIDES.

A TIDE is that regular motion of the waters of the ocean by which they rise and fall in certain intervals of time. The rising of the water is called the *flux*, or *flood;* and its falling, the *reflux*, or *ebb.* When the water has attained its greatest height it is said to be *high water*, and when it is done falling it is called *low water.*

These periodical motions of the waters are effected by the unequal attraction of the Sun and Moon, but chiefly that of the latter object, on the different parts of the Earth. For the discovery of the laws by which this general principle of attraction is governed, we are indebted to the great Sir Isaac Newton, who has demonstrated that the power of attraction diminishes as the distance increases, in proportion to the squares of those distances.

Now it is evident by the above law, that those parts of the earth nearest the moon are more attracted by her than the central parts, and that the central parts will be more attracted than those which are farthest from her, and therefore the distance between the Earth's center and the waters upon its surface under and opposite to the Moon, will be increased; so that if the Earth's surface were covered with water, it would assume a spheroidal, or egg-like figure, the longest diameter of which would be directed to the Moon's center. Hence those parts of the Earth directly under and opposite the Moon, that is, where the Moon is in the zenith and nadir, will have the flood or high water at the same time; while those parts at 90 degrees distance, or where the Moon appears in the horizon, will have the ebb or lowest water at that time. As the Moon apparently shifts her position from east to west in going round the Earth every day, the longest diameter of the spheroid following her motion, occasions two floods and ebbs, in about every 24 hours and 49 minutes, which is the length of a lunar day, or the interval between the Moon's passing the meridian of any place, and returning to the same again.

The Earth's diameter bears a considerable proportion to its distance from the Moon, but is next to nothing when compared to its distance from the Sun; therefore the difference of the Sun's attraction on the sides of the Earth under and opposite to him, is much less than the difference of the Moon's attraction on the sides of the Earth under and opposite to her, and consequently the Moon must raise the tides much higher than they can be raised by the Sun.

From this theory it may be thought the tides ought to be highest directly under and opposite the Moon. But we find, that in open seas, where the water flows freely, the Moon is generally past the meridian when it is high water. The reason is obvious; for though the Moon's attraction were to cease altogether, when she was past the meridian, yet the motion of ascent communicated to the water before that time, would make it continue to rise for some time after; much more must it do so when the attraction is only something diminished.

The times of high water do not always answer to the same distance of the Moon from the meridian at the same places; but are variously affected by the action of the Sun, which brings them on sooner when the Moon is in her first and third quarters, and keeps them back later when she is in her second and fourth; because in the former case, the tide raised by the Sun alone would be earlier than the tide raised by the Moon, and in the latter case, later.

When the Moon is in *perigee*, or at her nearest distance from the Earth, she attracts strongest, and therefore raises the tides most; the contrary happens when she is in *apogee*, or at her greatest distance from the Earth, because of her weaker attraction. At new Moon, when the Moon is in conjunction with the Sun, the tides are raised by the joint attractions of both luminaries, and therefore will be highest; the same is the case at full Moon, when the Sun and Moon are in opposition: for whilst the Moon raises the tides under and opposite her, the Sun acting in the same line, raises the tides under and opposite to him, whence their conjoint effect is the same as at the change, and in both cases occasions what are called *spring tides.* But at the quarters the Sun raises the tides where the Moon depresses them, and depresses them where they would be raised by the Moon; hence it is the difference of their actions that produces the tides at the quarters, and these are called *neap tides.* But these tides do not happen till a day or two after the above times, because in this, as in other cases, the effect is not greatest or least when the immediate influence of the cause is greatest or least, but some time afterward.

The Sun being nearer the Earth at the beginning, than at any other time of the year, its attraction will then be most powerful, and of course, about January the spring tides will be greater than at any other time, and greatest of all if the Moon at the same time should happen to be in perigee.

When the Moon is in the equinoctial, the tides are equally high in both parts of the lunar day, but as the Moon declines from the equinoctial towards either pole, the tides are alternately higher and lower at places having north or south latitude. Whilst the Moon has north declination, the greatest tides in the northern hemisphere are when she is above the horizon, and the reverse whilst her declination is south.

The tides rise higher at any place in proportion as the Moon is nearer to the zenith or nadir of that place at the time of her passing the meridian, because the action of the Moon is there strongest;

nence the tides are greater between the tropics than any other parts, and less near the poles.

All the above particulars would exactly obtain were the whole surface of the Earth covered with deep water; but since there are a multitude of islands besides continents lying in the way of the tide which interrupt its direct course, there arise a great variety of other appearances which require particular solutions, wherein the situation of the shores, straits, shoals, winds, and other things, must be considered. For instance, as the sea has no known passage between Europe and Africa, let them be supposed one continent extending from Weigate Straits, in Latitude 78° north, to the Cape of Good Hope, in Latitude 34° south; the middle of these two would be in about 19° north, near Cape Blanco on the west coast of Africa. But it is impossible the flood-tide should set to the westward upon the western coast of Africa (for the general tide following the course of the Moon must set from east to west) because the continent for above 50 degrees, both northward and southward, bounds that sea on the east; therefore, if any regular tide, proceeding from the motion of the sea, from east to west, should reach this place, it must come either from the north of Europe southward, or from the south of Africa northward.

This opinion is further corroborated, or rather fully confirmed by common experience, which shews that the flood sets to the southward along the west Coast of Norway, from the North Cape to the Naze, or entrance of the Baltic Sea, and so proceeds to the southward along the east Coast of Great Britain, and in its passage supplies all those ports which lie in its way one after another. The Coast of Scotland has the tide first, because it comes from the northward to the southward. On the full and change days it is high water at Aberdeen at 0h. 45m.; but at Tynemouth-Bar not till 3h. rolling thence to the southward, it makes high water at the Spurn a little after 5h.; at Yarmouth Roads a little after 8h.; at Harwich 11h. 30m.; at the Nore a little after 12h., and at London at 2h. 46m. all in the same day. And although this may seem to contradict the hypothesis of the natural motion of the tides being from east to west, yet as no tide can come west from the main continent of Norway or Holland, it is evident the tide we have been tracing, by its several stages from Scotland to London, is supplied by that tide, the original motion of which is from east to west. As water always inclines to its level, it will in its passage fall to any other point of the compass to fill up vacancies where it finds them; and yet not contradict, but rather confirm the hypothesis.

From these circumstances it is evident that the direct course of the waters from east to west being interrupted by the land lying in their way, they are often obliged to make a long circuit, and to flow in various directions; whence the setting of the tides and the times of high water are different at different places.

Lakes and inland seas, such as the Caspian Sea, the Mediterranean, and the Baltic Seas, have little or no sensible tides, for they are usually so small that the attractive influence of the Sun and Moon is nearly equal at both extremities, and cannot therefore sensibly affect the water.

When the time of high water at any place is mentioned generally, it is to be understood of the time when it is high water at that place on the day of new or full Moon; or the time past noon when it is high water on the day on which the Sun and Moon are together on the meridian of the place. Among pilots it is customary to reckon the time of flood or high water by the point of the compass the Moon is supposed to bear on at that time, allowing three quarters of an hour for each point In places where it is flood at noon on the days of full and change, the tide is said to flow north and south, or at 12 o'clock. In places where the Moon is supposed to bear 1, 2, 3, 4, or more points to the east or west of the meridian, when it is high water on the same day, the tide is said to flow on such a point: so if the Moon is supposed to bear S. E. at flood, it is said to flow S. E. and N. W. or 3 hours before the Moon comes to the meridian, that is, at 9 o'clock; if she bears S. W. it flows S. W. and N. E. or at 3 hours after the southing, and in like manner for other points of the Moon's bearing. But this absurd custom of reckoning the tides by the bearing of the Moon should be exploded as founded in error; for the Moon takes a greater or less portion of time in passing over any given number of points of the compass.

In some places it is high water on the shore, or by the ground, while the tide continues to flow in the stream or offing; and according to the length of time it flows longer in the stream than on the shore, it is said to flow tide, and such part of tide, allowing 6 hours to a tide. Thus 3 hours longer in the offing than on the shore, makes tide and half tide; an hour and a half longer makes tide and quarter tide; three quarters of an hour longer makes tide and half quarter tide, &c.

The common method of finding the time of high water at any place is contained in the following particulars.

OF LEAP YEAR.

The length of the solar year being nearly 365 days 6 hours, and the common year containing only 365 days, one day is added every fourth year to the month of February, making that year contain 366 days, which is called *bissextile*, or *leap* year, and is found as follows:

To find the Leap Year.

RULE. Divide the given year by 4, and if there be no remainder it is leap year; but if 1, 2, or 3 remain, they shew that it is so many years after leap year.

EXAMPLE. The year 1830, divided by 4, gives 457, and the remainder 2, which shews that it is the second year after leap year.

OF THE GOLDEN NUMBER.

The Moon is observed to go through all her variety of aspects, with respect to the Sun, in the course of 19 years, so that at the end of that period, which is called the *lunar cycle*, the new and full Moons return on the same days of the Month, and nearly at the same hours. The year of the lunar cycle is called the *Golden Number* (from its having been formerly annexed to the Calendars in golden characters) and at the birth of Christ was 1; hence the following rule.

To find the Golden Number.

Rule. Add 1 to the given year, and divide the sum by 19; the remainder will be the golden number.

Example. Required the golden number for the year 1830.

Add 1 to the year 1830, and it makes 1831; this divided by 19, gives 96 for the quotient, and leaves 7 for the remainder, which is the golden number for the year 1830.

OF THE EPACT.

The Epact is the Moon's age at the beginning of the year: it increases 11 every year, being the excess of the solar year of 365 days, above the lunar year of 354 days, or 12 lunations, and goes through all its varieties in a period of 19 years: hence it happens that the same golden number has always the same epact, that is, when the golden number is 1, the epact is 0; when 2, the epact is 11; when 3, 22, &c. and as the golden number at the birth of Christ was 1, we have the following general rule.

To find the Epact.

Rule. Divide the given year by 19; multiply the remainder by 11, and the product will be the epact, if it does not exceed 29; but if it does, divide the product by 30, and the last remainder will be the epact.

Example. Required the Epact for the year 1830.

1830, divided by 19, gives 96 for the quotient, and 6 for the remainder, which multiplied by 11, gives 66; this, divided by 30, gives the quotient 2, and the remainder 6; which remainder is the epact for the year 1830.

OF THE NUMBER FOR THE MONTH.

The Number, or Epact for the month, is the Moon's age at the beginning of that month, when it is new Moon on the first of January; hence,

To find the Number of any given Month.

Rule. Divide the number of days contained in the preceding months, reckoning from the beginning of January, by 29.5, or rather 29.53 (the period of a mean lunation in days and decimal parts) and the nearest whole number to the remainder is the Epact, or number for the month required.

Example. Required the Number, or Epact, for September.

The days contained between the beginning of January and the beginning of September are 243; this number, divided by 29.53, gives the quotient 8, and the remainder 6.76, or 7 nearly, which is the Epact for September.

The Epacts, or Numbers for each month, are as follow.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
In common years...	0	1	0	1	2	3	4	5	7	7	9	9
In leap years	0	2	1	2	3	4	5	6	8	8	10	10

OF THE MOON'S AGE.

The Moon's age is the number of days that have elapsed since the last change, or the new Moon, and never exceeds 30.

To find the Moon's Age.

Rule. To the epact of the year add the number for the month and the day of the month; the sum, if it does not exceed 30, is the Moon's age; but if it does, subtract 30 from it, and the remainder will be the Moon's age.

Example. Required the Moon's age on July 24, 1830,

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19) 1830 (96
    171
    ---
     120
     114
     ---
       6
      11
     ---
30)  66 (2
     60
     ---
```

The Epact for 1830 =6

Epact for 1830	.	6
Number for the month	.	4
Day of the month	.	24
		34
		30
The Moon's age	.	4 **Days**

ON THE MOON'S SOUTHING.

The Moon's southing is the time she passes the meridian of any place, which is about 48 minutes, or $\frac{4}{5}$ of an hour later every day: now as the moon comes to the meridian with the Sun on the day of new Moon, the time that she comes to the meridian after the Sun on any day of her age, is easily found as follows:

To find the time of the Moon's southing, or passage over the Meridian.

Rule. Multiply the Moon's age by 4, and divide the product by 5; the quotient will be the hours, and the remainder multiplied by 12, the minutes past noon that the Moon comes to the meridian. Or multiply the moon's age by 8, and point off the right hand figure, then the left hand figure or figures will be the hours, and the product of the right hand figure by 6, the minutes past noon of the Moon's southing. If the hours exceed 12, subtract that time from them, and the remainder will be the time of the Moon's southing after midnight.

Example I. Required the time of the Moon's southing, July 1, 1830.

Epact for 1830 . .	6	Moon's age . .	11 Days
Number for the month .	4		4
Day of the month . .	1		
			5)44(4
Moon's age . .	11 Days		12
		Moon's southing .	8h. 48m. P.M.

Example II. At what time will the Moon pass the meridian, October 24 1829,

Epact for 1829 .	25	Moon's age . .	26 Days
Number for the month .	7		,8
Day of the month .	24		
	56		20,8
	30		,6
		Moon passes merid.	20h. 48m. P.M.
Moon's age . .	26 Days		12 0
		Or	8h. 48m. A.M.

To find the time of High Water at any place on any given day of the Moon's Age.

METHOD I.

Rule. To the time of the Moon's southing on the given day add the time of high water at the given place on the full and change days; (taken from Table XLIII.) their sum is the time of high Water at the place, past noon on the given day. If this sum exceed 12 hours 24 minutes, which is the interval between each succeeding tide, subtract 12 hours 24 minutes from it; or if it exceed 24 hours 48 minutes, subtract 24 hours 48 minutes from it, and the remainder will be the time of high water in the afternoon of the given day.

Example I. Required the time of high water at London, June 11, 1829.

Epact for 1829 . .	25	Moon's age June 11, 1829 .	9 Days
Number for June . .	3		4
Day of the month , .	11		
			5)36(1
	39		
	30	Moon's southing . .	7h. 12m.
		Time at London (Table XLIII)	2 46
Moon's age . .	9 Days		
		High Water at London .	9 58

Example II. At what time will it be high Water in the Downs, September 24, 1828.

Epact for 1828 . .	14	Moon's age, September 24, 1828	16 Days
Number for September .	8		,8
Day of the month . .	24		
			12h. 48m.
	46	Time at Downs (Table XLIII)	11 15
	30		
			24 3
Moon's age .	16 Days	Subtract the time of a tide =	12 24
		High water in the Downs .	11 39

The preceding method of finding the time of high water, which is that usually practised at sea, is founded on the supposition that the interval between the Moon's passing the meridan and the time of high water is always the same; but we have already observed, in the theory of the Tides, that the Sun brings on the tides sooner in the first and third quarters of the Moon, and later in the second and fourth quarters, than if they were produced by the influence of the Moon only: hence it will be subject to an error on this account; besides which the Moon's age, as above found, will frequently be more than a day, and the Moon's southing above an hour wide of the truth. We have therefore given a second and third method: the second will be found very expeditious and easy, but the third, in which the Moon's position with regard to the Sun and her distance from the Earth are taken into account, is recommended, as it will seldom deviate many minutes from the truth, unless when the tides are greatly influenced by the winds.

Table A.

YEARS.	MONTHS.								
	Jan.	Feb Apr.	Mar	May	June	July	Aug	Sept Oct	Nov Dec
1822	7	9	8	10	11	12	13	15	17
1823	18	20	19	21	22	23	24	26	28
1824	0	2	1	3	4	5	6	8	10
1825	11	13	12	14	15	16	17	19	21
1826	22	24	23	25	26	27	28	0	2
1827	3	5	4	6	7	8	9	11	13
1828	14	16	15	17	18	19	20	22	24
1829	25	27	26	28	29	0	1	3	5
1830	6	8	7	9	10	11	12	14	16
1831	17	19	18	20	21	22	23	25	27
1832	28	0	29	1	2	3	4	6	8
1833	9	11	10	12	13	14	15	17	19
1834	20	22	21	23	24	25	26	28	0
1835	1	3	2	4	5	6	7	9	11
1836	12	14	13	15	16	17	18	20	22
1837	23	25	24	26	27	28	29	1	3
1838	4	6	5	7	8	9	10	12	14
1839	15	17	16	18	19	20	21	23	25
1840	26	28	27	29	0	1	2	4	6

Table B.

CORRECTIONS

To be added to the Time of HIGH WATER at full and change.

☽'s Age.	Corr.		☽'s Age.	Corr.	
	h.	m.		h.	m
0	0	0	15	12	8
1	0	36	16	12	45
2	1	11	17	13	19
3	1	46	18	13	54
4	2	21	19	14	30
5	3	1	20	15	11
6	3	44	21	15	56
7	4	37	22	16	51
8	5	40	23	18	0
9	6	58	24	19	18
10	8	14	25	20	31
11	9	17	26	21	31
12	10	9	27	22	21
13	10	53	28	23	3
14	11	33	29	23	42
15	12	8	29¾	24	0

As the new and full Moons happen on the same days of each Month at the expiration of nineteen years (see page 165) Table A, which is calculated for that period, will answer during the present century, by changing the years after 1840; thus for 1822 write 1841, for 1823 write 1842, and so on in a regular succession to 1859; and when these years are elapsed, begin again with 1860, &c.

METHOD II.

Rule. To the number found in Table A, answering to the given year in the left side column, and the given month at the top, add the day of the month; the sum will be the Moon's age on the given day, if it does not exceed 29; but if it does, subtract 30 from it, and the remainder will be her age: then opposite the Moon's age, in Table B. will be found a number of hours and minutes, which added to the time of high water at the given place on full and change days, their sum will be the time of high water at the place, past noon on the given day, from which subtract 12h. 24m. or 24h. 48m. as before, if it exceeds those times.

Example I. Required the time of high water at London, on March 13, 1829.

In Table A, opposite 1829, and under March, stands the number 26, to which add 13, the day of the month, their sum is 39, from which subtract 30, and the remainder 9 is the Moon's age. Now in Table B, opposite the Moon's age 9, stands 6h. 58m. to which add 2h. 46m., the time at London on full and change days, (taken from Table XLIII) their sum 9h. 44m. is the time of high water at London on March 13, 1829, in the afternoon.

Example II. At what time will it be high water in the Downs on September 21, 1831?

	h.	m.
The Moon's age, by Table A, is 16 days; opposite to which in Table B is	12	45
High water in the Downs, full and change days, (Table XLIII.) .	11	15
	24	0
	12	24
High water in the Downs, September 21st, 1831 . .	11	36 P.M.

METHOD III.

Rule. Find the time of the Moon's passing the meridian on the given day, in page VI. of the month in the Nautical Almanac, and reduce it to the time of her passing the meridian of the given place by Table XVI.; with this time, and the Moon's semidiameter from page VII. of the Nautical Almanac, take out the corresponding correction from Table XV.*, which add to, or subtract from, the above time, as directed in the Table; to the sum or remainder add the time of high water at the given place on full and change days (Table XLIII.) and the sum will be the time of high water past noon of the given day. But if the sum exceed 12h. 24m. or 24h. 48m. subtract those times from it, and the remainder will be the time of high water, in the afternoon, nearly.

But should greater accuracy be required, proceed thus:

If the above sum be more than 12 hours, and less than 24 hours, the time of high water found as above, will be that on the following morning; in this case, therefore, to find it for the afternoon of the given day, diminish the Moon's passage over the meridian of the ship by half the difference of the passages on the given and preceding days; then proceed as before; rejecting 12 hours from the result. Again, if the above sum be greater than 24 hours, it will be the time of high water after noon of the following day; when this is the case, diminish the Moon's passage over the meridian of the ship by the whole difference between the passages on the given and preceding days, and proceed as before, rejecting 24 hours from the result.

When the time of high water is found for the afternoon of the given day, the time of high water on the preceding morning may be found by subtracting 24 minutes from it, or, on the following morning, by adding 24 minutes to it.*

EXAMPLE I. Required the time of high water at Falmouth, on October 23d, 1830.

		h.	m.	
Moon's passage over the meridian by Nautical Almanac .		5	15	
Correction for that time and Moon's semidiameter 15′ (Table XV*) .	—	1	4	
		4	11	
Time of high water at Falmouth, full and change days, (Table XLIII.) .		5	30	
Time of high water at Falmouth, October 23d, 1830 . .		9	41	P.M.

EXAMPLE II. Required the time of high water at Calcutta, in longitude 88° 28′ E. on January 7th, 1830.

		h.	m.	
Moon's passage over the meridian of Greenwich, January 7th, by Nautical Almanac		10	56	
Correction to daily var. 55m. and longitude 88° 28′ E. (Table XVI.) .	—		13	
Time of Moon's passing the meridian of Calcutta . .		10	43	
Correction to that time and Moon's semidiameter 15′ 39″ (Table XV.*)	+	0	19	
		11	2	
Time of high water at Calcutta, full and change days (Table XLIII.) .		3	5	
		14	7	
		12	24	
Time of high water at Calcutta, January 7th, 1830 . .		1	43	P.M.
			24	
Time of high water at Calcutta on the following morning .		2	7	A.M.
Time of high water at Calcutta on the preceding morning .		1	19	A.M.

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* It is to be observed that the above methods give the times of high water in *solar* or *apparent time*, to which therefore the equation of time (taken from page II. of the month in the Nautical Almanac), must be applied, to reduce them to ***mean time***, or that shewn by a watch.

Example III. Required the time of high water at Halifax, in longitude 63° 32′ W. on August 13th, 1830.

	h.	m.
Moon's passage over the meridian of Greenwich, August 13th, by Nautical Almanac . . .	20	27
Correction to daily var. 55m. and longitude 63° 32′ W. (Table XVI.) .	+	10
Time of Moon's passing the meridian of Halifax .	20	37
Correction for that time and Moon's semidiameter 15′ 48″ (Table XV*) .	+	21
	20	58
Time of high water at Halifax, full and change, (Table XLIII.) .	7	30
	28	28
	24	48
Time of high water at Halifax, August 13th, 1830 .	3	40 P.M.

The last two Examples may be worked more correctly as follows·

Example II. Required the time of high water at Calcutta, in longitude 88° 28′ East, on January 7th, 1830.

	h.	m.
Moon's passage over the meridian of Greenwich, January 7th, by Nautical Almanac . . .	10	56
Correction to daily var. 55m. and longitude 88° 28′ E. (Table XVI.) .	−	13
Time of Moon's passing the meridian of Calcutta .	10	43
Half the diff. of passages on the given and preceding days .	−	27
	10	16
Correction to 10h. 16m. and Moon's semidiameter 15′ 39″ (Table XV.*) .	+	22
	10	38
Time of high water at Calcutta, full and change, (Table XLIII.) .	3	5
	13	43
Subtract	12	
Time of high water at Calcutta, January 7th, 1830 .	1	43 P.M

Example III. Required the time of high water at Halifax, in longitude 63° 32′ W. on August 13th, 1830.

	h.	m.
Moon's passage over the meridian of Greenwich, August 13th, by Nautical Almanac . . .	20	27
Correction to daily var. 55m. and longitude 63° 32′ W. (Table XVI.) .	+	10
Time of Moon's passing the meridian of Halifax, August 13th .	20	37
Difference of passages on the given and preceding days .	−	55
Time of Moon's passing the meridian of Halifax, August 12th .	19	42
Correction to that time and Moon's semidiameter 15′ 48″ (Table XV.*) .	−	8
	19	34
High water at Halifax, full and change, (Table XLIII.) .	7	30
	27	4
Subtract . . .	24	
Time of high water at Halifax, August 13th, 1830 .	3	4 P.M.

To find the time of high water at a given place on the full and change days of the Moon, when the time of high water is known at that place on any other day.

Rule. Reduce the time of the Moon's passing the meridian of Greenwich, found in page VI. of the month in the Nautical Almanac, to the time of her passing over the meridian of the given place, by Table XVI; to this time apply the correction from Table XV*, and subtract the result from the observed time of high water on the given day; the remainder will be the time of high water at the given place, on full and change days.

But should the time to be subtracted be greater than the observed time of high water, from the time of the Moon's meridian passage over the given place, subtract half the difference of two successive passages, and then proceed as before, adding 12 hours to the observed time of high water. Again, should the time to be subtracted be still the greater, take the whole difference of two successive passages from the time of the Moon's passing the meridian of the place, and proceed as before, adding 24 hours to the observed time of high water.

Example I.

Suppose that in the harbour of Rio Janeiro, in South America, June 27th, 1830 the time of high water should be at 6h. 54m. in the afternoon; required the time of high water on the full and change days of the Moon.

	h.	m.
Moon's passage over the meridian of Greenwich, June 27th, 1830, by Nautical Almanac . . .	5	43
Correction to daily var. 42m. and longitude 43° 3′ W. (Table XVI.) .	+	5
Time of Moon's passing the meridian of Rio Janeiro .	5	48
Correction to that time, and Moon's semidiameter 14′ 52″ (Table XV.*)	—	59
	4	49
Observed time of high water	6	54
Time of high water at Rio Janeiro, on full and change days .	2	5 P.M.

Example II.

Suppose that in the harbour of New York, on February 8th, 1830, the time of high water should be at 9h. 21m. P. M. required the time of high water on the full and change days.

	h.	m.
Moon's passage over the meridian of Greenwich, February 8th, 1830, by Nautical Almanac . . .	12	51
Correction to daily var. 44m. and longitude 74° 5′ W. .	+	9
Time of Moon's passing the meridian of New York, February 8th	13	0
Half the difference of successive passages .	—	22
	12	38
Correction to 12h. 30m. and Moon's semidiameter 14′ 56″ (Table XV.*)	—	11
	12	27
Observed time of high water + 12 hours	21	21
Time of high water at New York, full and change days .	8	54 P.M.

DESCRIPTION AND USE

OF

HADLEY'S QUADRANT.

IT is generally allowed that we are indebted to John Hadley, Esq. for the invention, or at least the first public account, of that admirable instrument, commonly called Hadley's Quadrant, who, in the year 1731, first communicated its principles to the Royal Society, which were by them published soon after in their Philosophical Transactions; before this period the Cross Staff, and Davis's Quadrant, were the only instruments used for measuring altitudes at sea, both very imperfect, and liable to considerable error in rough weather; the superior excellence, however, of Hadley's Quadrant, soon obtained its general use among seamen, and the many improvements this instrument has received from ingenious men at various times, have rendered it so correct, that it is now applied, with the greatest success, to the important purposes of ascertaining both the latitude and longitude at sea.

Figure 1, Plate VIII. is a representation of Hadley's Quadrant; the principal parts of which are, the Octant, or Frame ABC; the Arch, or Limb BC; the Index D; the Nonius, or Vernier Scale E; the Index Glass F; the Fore Horizon Glass G; the Back Horizon Glass H; the Shades, or Dark Glasses I; and the Sight Vanes K and L.

The OCTANT or FRAME, is generally made of ebony, or other hard wood, and consists of an arch firmly attached to two radii or bars AB, AC, which are strengthened and bound by the two braces M and N, in order to prevent it from warping.

The ARCH or LIMB, although only the eighth part of a circle, is, on account of the double reflection, divided into 90 degrees, numbered 0, 10, 20, 30, &c. from right towards the left; these are subdivided into 3 parts, containing each 20 minutes, which are again subdivided into single minutes, by means of a scale at the end of the Index. The arch extending from 0 towards the right hand is called the *arch of excess.*

The INDEX is a flat brass bar, that turns on the center of the instrument; at the lower end of the Index there is an oblong opening: to one side of this opening a Nonius scale is fixed, to subdivide the divisions of the arch; at the bottom, or end of the Index, there is a piece of brass which bends under the arch, carrying a spring to make the Nonius scale lie close to the divisions; it is also furnished with a screw, to fix the Index in any desired position.

Some instruments have an *adjusting* or *tangent-screw*, fitted to the Index, that it may be moved more slowly, and with greater regularity and accuracy than by the hand; it is proper, however, to observe, that the Index must be previously fixed near its right position by the above-mentioned screw, before the adjusting screw is put in motion.

The NONIUS is a scale fixed to the end of the Index for the purpose, as before observed, of dividing the subdivisions on the Arch into Minutes; it sometimes contains a space of 7 degrees, or 21 subdivisions of the limb, and is divided into 20 equal parts; hence each division on the Nonius will be one-twentieth part greater, that is, one minute longer than the divisions on the Arch; consequently, if the first division of the Nonius, marked 0, be set precisely opposite to any degree, the relative position of the Nonius and the Arch must be altered one minute before the next division on the Nonius will coincide with the next division on the Arch; the second division will require a change of two minutes, the third of three minutes, and so on, till the 20th stroke on the Nonius arrives at the next 20 minutes on the Arch; the 0 on the Nonius will then have moved exactly 20 minutes from the division whence it set out, and the intermediate divisions of each minute have been regularly pointed out by the divisions of the Nonius.

The divisions of the Nonius scale are in the above case reckoned from the middle towards the right, and from the left towards the middle; therefore the first 10 minutes are contained on the right of the 0, and the other 10 on the left. But this method of reckoning the divisions being found inconvenient, they are more generally counted, beginning from the right hand towards the left; and then 20 divisions on the Nonius are equal to 19 on the limb, consequently one division on the Arch will exceed one on the Nonius by one-twentieth part, that is, one minute.

The 0 on the Nonius points out the entire degrees and odd twenty minutes subtended by the objects observed; and if it coincides with a division on the Arch, points out the required angle; thus, suppose the 0 on the Nonius stands at 25 degrees, then 25 degrees will be the measure of the angle observed, if it coincides with the next division on the left hand, 25 degrees 20 minutes is the angle; if with the second division beyond 25 degrees, then the angle will be 25 degrees 40 minutes; and so on in every instance where the 0 on the Nonius coincides with a division on the Arch; but if it does not coincide, then look for a division on the Nonius that stands directly opposite to one on the Arch, and that division on the Nonius gives the odd minutes to be added to that on the Arch nearest the right-hand of the 0 on the Nonius; for example, suppose the Index division does not coincide with 25 degrees. but that the next division to it on the Nonius is the first coincident division, then is the required Angle 25 degrees 1 minute; if it had been the second division, the Angle would have been 25 degrees 2 minutes, and so on to 20 minutes, when the 0 on the Nonius would coincide with the first 20 minutes on the Arch from 25 degrees. Again, let us suppose the 0 on the Nonius to stand between 50 degrees and 50 degrees 20 minutes, and that the 15th division on the Nonius coincides with a division on the Arch, then is the angle 50 degrees 15 minutes. Further, let the 0 on the Nonius stand between 45 degrees 20 minutes and 45 degrees 40 minutes, and at the same time the 14th division on the Nonius stands directly opposite to a division on the Arch, then will the Angle be 45 degrees 34 minutes.

The INDEX GLASS is a plane speculum, or mirror of glass quicksilvered, set in a brass frame, and so placed that the face of it is perpendicular to the plane of the instrument, and immediately over the center of motion of the Index. This mirror being fixed to the Index moves along with it, and has its direction changed by the motion thereof.

This glass is designed to reflect the image of the Sun, or any other object, upon either of the two horizon glasses, from whence it is reflected to the eye of the observer. The brass frame, with the glass, is fixed to the Index by the screw R; the other screw S serves to place it in a perpendicular position, if by any accident it has been put out of order.

The HORIZON GLASSES are two small speculums on the radius A B of the Octant; the surface of the upper one is parallel to the Index glass when the 0 on the Nonius is at 0 on the Arch; these mirrors receive the rays of the object reflected from the Index glass, and transmit them to the observer. The fore horizon glass G is only silvered on its lower half, the upper half being transparent, in order that the direct object may be seen through it. The back Horizon glass H is silvered at both ends; in the middle there is a transparent slit, through which the Horizon may be seen. Each of these glasses is set in a brass frame, to which there is an axis; this axis passes through the wood work, and is fitted to a lever on the under side of the quadrant, by which the glass may be turned a few degrees on its axis, in order to set it parallel to the Index glass.

To set the glasses perpendicular to the plane of the quadrant, there are two sunk screws, one before and one behind each glass: these screws pass through the plate on which the frame is fixed into another plate, so that by loosening one and tightening the other of these screws, the direction of the frame, with its mirror, may be altered, and thus be set perpendicular to the plane of the instrument.

The DARK GLASSES, or SHADES, are used to prevent the bright rays of the Sun, or glare of the Moon, from hurting the eye at the time of observation; there are generally three of them, two red, and one green. They are each set in a brass frame which turns on a center, so that they may be used separately or together, as the brightness of the object may require. The green glass may be used also alone, if the Sun be very faint; it is likewise used in taking observations of the Moon; when these glasses are used for the fore observation, they are fixed as in Figure 1, but for the back observation, they are removed to O.

The SIGHT VANES are pieces of brass, standing perpendicular to the plane of the instrument: that one which is opposite the fore horizon, is called *the fore Sight Vane*, the other *the back Sight Vane.* There are two holes in the fore Sight Vane, the lower of which, and the upper edge of the silvered part of the fore Horizon glass, are equidistant from the plane of the instrument, and the other is opposite to the middle of the transparent part of that glass; the back Sight Vane has only one hole, which is exactly opposite to the middle of the transparent slit in the Horizon glass to which it belongs

ADJUSTMENTS OF HADLEY'S QUADRANT.

The several parts of the Quadrant being liable to be out of order from a variety of accidental circumstances, it is necessary to examine and adjust them, so that the instrument may be put into a proper state previous to taking observations.

An instrument properly adjusted, must have the Index glass and Horizon glasses perpendicular to the plane of the Quadrant; the plane of the fore Horizon glass parallel, and that of the back Horizon glass perpendicular to the plane of the Index glass, when the 0 on the Nonius is at 0 on the Arch: hence the Quadrant requires five adjustments, the first three of which being once made, are not so liable as the last two to be out of order: however they should all be occasionally examined in case of accident.

I *To set the Plane of the Index Glass perpendicular to that of the Instrument.*

Place the Index near to the middle of the Arch, and holding the Quadrant in a horizontal position, with the Index glass close to the eye, look obliquely down the glass, in such a manner that you may see the Arch of the Quadrant by direct view, and by reflection at the same time; if they join in one direct line, and the Arch seen by reflection forms an exact plane, or strait line, with the Arch seen by direct view, the glass is perpendicular to the plane of the Quadrant; if not, it must be restored to its right position by loosening the screw R, and tightening the screw S, or vice versa, by tightening the screw S, and releasing the screw R.

II. *To set the Fore Horizon Glass parallel to the Index Glass, the Index being at 0.*

Set the 0 on the Nonius exactly against 0 on the Arch, and fix it there by the screw at the under side. Then, holding the Quadrant vertically, with the Arch lowermost, look through the Sight Vane K, at the edge of the sea, or any other well defined and distant object. Now, if the Horizon in the silvered part exactly meets, and forms one continued line with that seen through the unsilvered part, the

Horizon glass is parallel to the Index glass. But if the Horizons do not coincide, then loosen the button-screw in the middle of the lever, on the under side of the Quadrant, and move the Horizon glass on its axis, by turning the nut at the end of the adjusting lever, till you have made them perfectly coincide; then fix the lever firmly in this situation by tightening the button-screw. This adjustment ought to be repeated before and after every observation. Some observers adopt the following method, which is called finding the *Index error.* Let the Horizon glass remain fixed, and move the Index till the image and object coincide; then observe whether 0 on the Nonius agrees with 0 on the Arch, if it does not, the number of minutes by which they differ is to be added to the observed altitude or angle, if the 0 on the Nonius be to the right of the 0 on the Arch, but if to the left of the 0 on the limb, it is to be subtracted.

It has already been observed, that that part of the Arch beyond 0, towards the right hand, is called the Arch of excess: the Nonius, when the 0 on it is at that part, must be read the contrary way, or, which is the same thing, you may read off the minutes in the usual way, and then their complement to 20 minutes will be the real number, to be added to the degrees and minutes pointed out by the 0 on the Nonius.

III. *To set the Fore Horizon Glass perpendicular to the Plane of the Quadrant.*

Having previously made the above adjustment, incline the Quadrant on one side as much as possible, provided the Horizon continues to be seen in both parts of the glass; if when the instrument is thus inclined, the edge of the sea seen through the lower hole of the Sight Vane continues to form one unbroken line, the Horizon glass is perfectly adjusted; but if the reflected Horizon be separated from that seen by direct vision, the speculum is not perpendicular to the plane of the Quadrant: then if the limb of the Quadrant is inclined towards the Horizon, with the face of the instrument upwards, and the reflected sea appears higher than the real sea, you must slacken the screw before the Horizon glass, and tighten that which is behind it; but if the reflected sea appears lower, the contrary must be performed. Care must be always taken in this adjustment to loosen one screw before the other is screwed up, and to leave the adjusting screws tight, or so as to draw with a moderate force against each other.

This adjustment may be also made by the Sun, Moon, or a Star; in this case the Quadrant is to be held in a vertical position; if the image seen by reflection appears to the right or left of the object seen directly, then the glass must be adjusted as before by the two screws: this will be further explained in the use of the Sextant.

It will be necessary, after having made this adjustment, to examine if the Horizon glass still continues to be parallel to the Index glass, as sometimes by turning the sunk screws the plane of the Horizon glass will have its position altered.

IV. *To set the Back Horizon Glass perpendicular to the Plane of the Index Glass,* 0 *on the Nonius being at* 0 *on the Arch.*

Let the 0 on the Nonius be put as much to the right of 0 on the Arch as twice the dip (taken from Table V.) amounts to: hold the Quadrant in a vertical position, and apply the eye to the back Sight Vane L; then if the reflected Horizon, which will appear inverted, or upside down, coincide with that seen direct, the glass is adjusted; otherwise the screw in the middle of the lever on the under side of the Quadrant must be slackened, and the nut at its extremity turned till both horizons coincide.

V. *To set the Back Horizon Glass perpendicular to the Plane of the Quadrant.*

This adjustment is performed by holding the Quadrant nearly parallel to the Horizon, and directing the sight through the back Sight Vane; then, if the true and reflected Horizons appear in the same strait line, the glass is perpendicular to the plane of the instrument, but if they do not coincide, turn the sunk screws in the pedestal of the glass till both appear to form one strait line.

USE OF HADLEY'S QUADRANT.

The use of the Quadrant is to ascertain the Angle subtended by two distant objects at the eye of the observer; but principally to observe the altitude of a celestial object above the Horizon: this is pointed out by the Index, when one of the objects seen by reflection is made to coincide with the other, seen through the transparent part of the Horizon Glass.

There are two different methods of observing altitudes with a Quadrant; one is when the observer's face is directed towards the celestial body, and it is brought down by reflection to that part of the Horizon immediately under it; the Altitude is in this case said to be taken by a *fore observation:* the other method is when the observer's back is towards the object, and it is brought over to the opposite part of the Horizon, and is thence called a *back observation.* This latter method of observing is very seldom used, and is requisite only when the Horizon under the object is broken by adjacent shores, or rendered indistinct by fogs, or any other impediments.

To take an Altitude of the Sun, Moon, or a Star, by a Fore Observation.

Having previously adjusted the instrument, place the 0 on the Nonius opposite to 0 on the Arch, and turn down one or more of the screens, according to the brightness of the Sun; then apply the eye to the upper hole in the fore Sight Vane, if the Sun's image be very bright, otherwise to the lower, and holding the Quadrant vertically, look directly towards the Sun, so as to let it be behind the silvered part of the Horizon glass, then the coloured Sun's image will appear on the speculum; move the Index forwards till the Sun's image, which will appear to descend, just touches the Horizon with its lower or upper limb; if the upper hole be looked through, the Sun's image must be made to appear in the middle of the transparent part of the Horizon glass, but if it be the lower hole, hold the Quadrant so that the Sun's image may be bisected by the line joining the silvered and transparent parts of the Horizon glass.

The Sun's limb ought to touch that part of the Horizon immediately under the Sun, but as this point cannot be exactly ascertained, it will be therefore necessary for the observer to give the Quadrant a slow motion from side to side, turning at the same time upon his heel, by which motion the Sun will appear to sweep the Horizon, and must be made just to touch it at the lowest part of the Arch; the degrees and minutes then pointed out by the Index on the Limb of the Quadrant will be the observed altitude of that limb which is brought in contact with the Horizon.

In this manner the altitude of the Moon, or a Star, may be taken by a fore observation, remembering that when the Moon is the object her enlightened side is to be brought to the Horizon, whether it be the upper or lower limb.

When the meridian or greatest altitude is required, the observation should be commenced a short time before the object comes to the meridian; being brought down to the Horizon, it will appear for a few minutes to rise slowly; when it is again to be made to coincide with the Horizon by moving the Index forward; this must be repeated until the object begins to descend, when the Index is to be secured, and the observation to be read off.

Note. For the methods of finding the time of the Moon's, or a Star's, passing the meridian, see the explanation to Tables XIII. XV, and XVI.

To take an Altitude of the Sun, Moon, or a Star, by a Back Observation.

Place the dark glasses in the hole near the back Horizon glass, and turn one or more of them down, according to the brightness of the Sun, then looking through the back Sight Vane towards that part of the Horizon opposite the Sun, the Quadrant being held vertically, move the Index till the Sun's image is seen on the silvered part of the glass, and giving the Quadrant a slow vibratory motion, the Sun will appear to describe an Arch with its convex side upwards; bring one of the limbs in contact with that part of the Horizon seen through the transparent slit, when it is in the upper part of this Arch, and the degrees and minutes pointed out by the Index will be the altitude of the other limb, for in the back observation the image of the object is inverted. In the same manner the altitude of the Moon, or a Star, may be taken, observing to bring the enlightened limb of the Moon in contact with the Horizon.

OF FINDING THE

LATITUDE BY OBSERVATION.

THE Latitude of a place is its distance from the equator, either north or south, and is measured by an arch of a meridian contained between the zenith and the equinoctial: hence, if the distance of any heavenly body from the zenith when on the meridian, and its declination, or number of degrees and minutes it is to the northward or southward of the equinoctial, be given, the Latitude may thence be found.

The meridian zenith distance of an object is found either from its altitude taken when on the meridian, or from one or two altitudes observed when out of the meridian.

Altitudes of the Sun or Moon taken at sea require four corrections, in order to obtain the true altitude of their center: these are for semidiameter, dip, refraction, and parallax*. When the altitude of a Star is observed, the corrections for dip and refraction only are to be applied. The parallax of the Sun or a Planet being but a few seconds is seldom noticed in finding the Latitude at sea.

To find the Latitude of a Place by the meridian Altitude of the Sun.

RULE. To the observed altitude of the Sun's lower limb add the Sun's semidiameter (16 minutes); but if the upper limb be observed, subtract it; from this sum or remainder subtract the dip answering to the height of the eye, (found in Table V.) when the altitude is taken by a fore observation; or add it in a back observation; and the result will be the apparent altitude of the Sun's center.

From the apparent altitude of the Sun's center subtract the refraction answering to that altitude, taken from Table IV.† and the remainder will be the true altitude of the Sun's center‡; or, when the altitude of the Sun's lower limb is observed, by a fore observation, the correction for the joint effect of the semidiameter, dip, refraction, and parallax, may be taken at once from Table IX.

Subtract the true altitude of the Sun's center from 90°, and the remainder will be the Sun's true meridian zenith distance, which is to be called north or south, according as the observer is north or south of the Sun, at the time of observation.

Take the Sun's declination from Table X. and reduce it to the meridian of the Ship, (when the Longitude is considerable) by

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* For an explanation of these corrections see page 150, &c.

† The refraction ought in strictness to be taken out for the apparent altitude of the observed limb; that is, for 16 minutes less than the apparent altitude of the center when the lower limb is observed, or 16 minutes more, when the upper limb; but the error, amounting to no more than a few seconds, and that only in low altitudes, will not be material in correcting altitudes taken at sea.

‡ It is a custom among seamen to add 11 or 12 minutes to the observed altitude of the lower limb (being the difference between the semidiameter and the dip) and to omit the correction for refraction altogether; but this neglect will frequently produce an error of several miles in the Latitude, especially when the meridian altitude is small.

Table XI, noting whether it be north or south. Then if the zenith distance and declination be both north or both south, add them together; but if one be north and the other south, subtract the less from the greater, and the sum or difference will be the Latitude, of the same name with the greater.

Note. If it be required to work the observation to seconds the Sun's semidiameter is to be taken from page III. of the month in the Nautical Almanac; the declination from page II. of the same, and the latter reduced to the meridian of the Ship by Table XXI. When the horizon under the Sun is obstructed by land, the dip is to be taken from Table VIII.

EXAMPLE I.

June 18, 1828, the meridian altitude of the Sun's lower limb was 43° 18′, the observer being north of the Sun, and his eye elevated 18 feet above the surface of the sea: required the latitude of the place of obervation.

	° ′	
Obs. alt. Sun's lower limb	43 18	
Sun's semidiameter	+ 16	
Obs. alt. Sun's center	43 34	
Dip of the horizon	— 4	
App. alt. Sun's center	43 30	
Refraction	— 1	
True alt. Sun's center	43 29	
	90	
Sun's zenith distance	46 31	N.
Sun's declination	23 26	N.
Latitude	69 57	N.

EXAMPLE II.

September 21, 1829, in longitude 60° E. the meridian altitude of the Sun's lower limb was 56° 26′, the observer being south of the Sun, and the height of his eye 26 feet: required the latitude.

		° ′	
Obs. alt. Sun's lower limb		56 26	
Semidiameter	+ 16′	+ 11	
Dip of hor.	— 5		
App. alt. Sun's center		56 37	
Refraction		— 1	
True alt. Sun's center		56 36	
		90	
Sun's zenith distance		33 24	S.
Sun's declination	0° 44′	0 48	N.
Corr. for long.	+ 4		
Latitude		32 36	S.

EXAMPLE III.

January 9, 1828, in longitude 116° W. the meridian altitude of the Sun's upper limb was 69° 14′ south, the observer being about 3 miles from the land under the Sun, and his eye elevated 22 feet: required the latitude.

		° ′	
Obs. alt. Sun's upper limb		69 14	
Semidiameter	— 16′	— 21	
Dip (Table VIII.)	— 5		
App. alt. Sun's center		68 53	
Refraction		— 0	
True alt. Sun's center		68 53	S.
		90	
Sun's zenith distance		21 7	N.
Sun's declination	22° 13′	22 10	S.
Corr. for long.	— 3		
Latitude		1 3	S.

EXAMPLE IV.

December 25, 1829 in longitude 35° W. the meridian altitude of the Sun's lower limb, by a back observation, was 16° 28′ south, the height of the eye being 20 feet: required the latitude.

		° ′	
Obs. alt. Sun's lower limb		16 28	
Semidiameter	+ 16′	+ 20	
Dip	+ 4		
App. alt. Sun's center		16 48	
Refraction		— 3	
True alt. Sun's center		16 45	S.
		90	
Sun's zenith distance		73 15	N.
Sun's declination	23° 25′	23 25	S.
Corr. for long.	— 0		
Latitude		49 50	N.

EXAMPLE V

May 29th, 1830, in longitude 30° West, the meridian altitude of the Sun's lower limb was observed to be 65° 42′ 30″, the zenith being north of the Sun, and the height of the eye 24 feet: required the latitude.

	°	′	″	
Sun's declin. by Naut. Alm. .	21	35	14	N.
Corr. for long. 30° W. (XXI.)	+ 0		49	
Sun's reduced declination .	21	36	3	N.
	°	′	″	
Obs. alt. Sun's lower limb .	65	42	30	
Sun's semid. by Naut. Alm. .	+	15	48	
Obs. alt. Sun's center .	65	58	18	
Dip of the horizon . .	—	4	42	
App. alt. Sun's center . .	65	53	36	
Refraction	—		25	
True alt. Sun's center .	65	53	11	
	90			
Sun's zenith distance	24	6	49	N.
Sun's reduced declination .	21	36	3	N.
Latitude . . .	45	42	52	N.

EXAMPLE VI.

November 21, 1830, in longitude 165° E. the meridian altitude of the Sun's lower limb was observed to be 47° 36′ 45″ S. the height of the eye being 18 feet: required the latitude.

	°	′	″	
Sun's declin. by Naut. Alm. .	19	53	19	S.
Corr. for long. 165° E. (XXI.)	—	5	52	
Sun's reduced declination .	19	47	27	S.
	°	′	″	
Obs. alt. Sun's lower limb .	47	36	45	S.
Sun's semid. by Naut. Alm. .	+	16	13	
Obs. alt. Sun's center .	47	52	58	
Dip of the horizon .	—	4	4	
App. alt. Sun's center .	47	48	54	
Refraction . . .	—		51	
True alt. Sun's center .	47	48	3	
	90			
Sun's zenith distance .	42	11	57	N.
Sun's reduced declination .	19	47	27	S.
Latitude	22	24	30	N.

EXAMPLE VII.

August 22 1830, in longitude 8° West. the meridian altitude of the Sun's lower limb was 77° 49′ 30″, the observer being south of the Sun, the height of the eye 30 feet and the Index error 1′ 30″ to be added*: required the latitude.

	°	′	″	
Sun's declin. by Naut. Alm.	11	53	27	N.
Corr. for long. 8° W. (XXI)	— 0		27	
Sun's reduced declination .	11	53	0	N.
	°	′	″	
Obs. alt. Sun's lower limb .	77	49	30	
Index error to be added .	+	1	30	
Corr. obs. alt. Sun's lower limb	77	51	0	
Corr. from Table IX. 10′.2 =	+	10	12	
True alt. Sun's center .	78	1	12	
	90			
Sun's zenith distance .	11	58	48	S.
Sun's reduced declination .	11	53	0	N.
Latitude . . .	0	5	48	S.

EXAMPLE VIII.

October 12th, 1830, in longitude 30° E. the meridian altitude of the Sun's lower limb was 89° 54′ 30″ from the south point of the horizon, the height of the eye being 12 feet, and the Index error 2′ 0″ to be subtracted*: required the latitude.

	°	′	″	
Sun's declin. by Naut. Alm. .	7	18	40	S.
Corr. for long. 30° E. (XXI.)	—	1	52	
Sun's reduced declination .	7	16	48	S.
	°	′	″	
Obs. alt. Sun's lower limb .	89	54	30	S.
Index error to be subtracted	—	2	0	
Corr. obs. alt. Sun's lower limb	89	52	30	
Corr. from Table IX. 12′.7 =	+	12	42	
	90	5	12	
	90			
Zenith distance . .	0	5	12	S.
Sun's reduced declination .	7	10	48	S.
Latitude . . .	7	22	0	S.

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* When the horizon Glass of the Instrument has not been adjusted so as to be parallel to the Index Glass when 0 in the nonius is at 0 in the arch, the observed altitude is to be corrected for the *Index Error.*—See description and use of the Quadrant or Sextant.

*To find the Latitude by the meridian Altitude of a Star.**

Rule. Take out the Star's declination from Table XIV. and reduce it to the time of observation. From the observed altitude of the Star subtract the dip and refraction taken from Tables IV. and V. and the remainder will be the Star's true altitude, which subtracted from 90° will give the zenith distance: to be called north or south, according as the observer is north or south of the Star at the time of observation.

Then, if the zenith distance and declination be both north or both south, add them together; but if one be north and the other south, subtract the less from the greater, and the sum or difference will be the Latitude, of the same name with the greater.

EXAMPLE I.

January 24, 1830, about 8 o'clock in the evening, the meridian altitude of the Star Aldebaran was 52° 36′, the observer being north of the Star, and the height of his eye 20 feet: required the latitude.

		°	′	″	
Declin. of Aldebaran, 1820 .		16	8	20	N.
Ann. var. +7″·95 ×10=	+		1	20	
Dec. of Aldebaran, Jan. 1830 .		16	9	40	N.
Obs. alt. of Aldebaran . .		52	36		
Dip of horizon . . .	—		4		
App. alt. of Aldebaran .		52	32		
Refraction . . .	—		1		
True alt. of Aldebaran .		52	31		
		90			
Star's zenith distance .		37	29		N.
Star's declination .		16	10		N.
Latitude		53	39		N.

EXAMPLE II.

July 16, 1830, about 3 o'clock in the morning, the meridian altitude of the Star Fomalhaut, was 73° 36′ south, the height of the eye being 24 feet: required the latitude.

		°	′	″	
Declin. of Fomalhaut, 1820 .		30	34	26	S.
Ann. var. —19″.10×10½=	—		3	21	
Dec. of Fomalhaut, July 1830 .		30	31	5	S
Obs. alt. of Fomalhaut .		73	36	0	S
Dip of horizon .	—		4	42	
App. alt. of Fomalhaut .		73	31	18	
Refraction . . .	—			16	
True alt. of Fomalhaut .		73	31	2	
		90			
Star's zenith distance .		16	28	58	N.
Star's declination . .		30	31	5	S.
Latitude		14	2	7	S.

To find the Latitude by the meridian Altitude of a Planet.

Rule. From the observed altitude of the planet subtract the dip and refraction, to obtain the true altitude, which subtracted from 90° will give the zenith distance as before, and under this set the declination; then the sum or difference of the zenith distance and declination, according as they are of the same, or contrary names, will give the latitude of the same name with the greater.

Note. The declination of the planets, and the time of their passing the meridian, are given in page IV. of each month in the Nautical

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* For the method of finding the time of a Star's passing the meridian see the explanation to Table XIII. also the explanation to Table XV. where directions are given for finding what Star is on or near the meridian, and for observing its altitude.

Almanac for every sixth day; but may be found for any intermediate day by taking proportional parts.

EXAMPLE I.

March 13th, 1830, the meridian altitude of Saturn was 53° 37′, the observer being north of the planet, and the height of his eye 17 feet: required the latitude.

In page IV. of March, in the Nautical Almanac, the time of Saturn's passage over the meridian is 9h. 26m. P. M. and his declination 18° 15′ N.

	°	′
Obs. altitude of Saturn	53	37
Dip of horizon	—	4
Refraction	—	1
True altitude of Saturn	53	32
	90	
Zenith distance	36	28 N.
Declination	18	15 N.
Latitude	54	43 N.

EXAMPLE II.

On June 17th, 1830, the meridian altitude of Jupiter was 52° 26′ N. the height of the eye being 10 feet: required the latitude.

In page IV. of June, the time of the planet's passage over the meridian is about 2h. A. M.; his declination on the 13th, is 22° 37′ S. and on the 19th, 22° 42′ S.; hence the difference in 6 days is 5′; therefore, as 6 days : 5′ : : 4 days : 3′, which, added to 22° 37′ (because the declination is increasing) gives 22° 40′, the declination of Jupiter on June 17th.

	°	′
Obs. altitude of Jupiter	52	26 N.
Dip of horizon	—	3
Refraction	—	1
True altitude of Jupiter	52	22
	90	
Zenith distance	37	38 S
Declination	22	40 S.
Latitude	60	18 S.

To find the Latitude by the meridian Altitude of the Moon.

Rule. 1. In page VI. of the month, in the Nautical Almanac, find the time of the Moon's passing the meridian of Greenwich on the given day, which reduce to the time of her passing the meridian of the ship by Table XVI.

2. Turn the ship's longitude into time by Table XIX. and add it to the above time, if the longitude be west, but if it be east, subtract it: the sum or difference will be the *time at Greenwich* when the Moon passes the meridian of the place of observation.

3. From page VII. of the month, in the Nautical Almanac, take out the Moon's semidiameter and horizontal parallax, and reduce them to the time at Greenwich*; and to the semidiameter add the Moon's augmentation, taken from Table VII.

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* The Moon's horizontal parallax and semidiameter are reduced to the time at Greenwich thus: take them out for the nearest noon or midnight before and after the reduced time, and find their difference; then say, as 12 hours is to the difference in 12 hours, so is the reduced time since the preceding noon or midnight, to a proportional part; which being added to or subtracted from the horizontal parallax at the preceding noon or midnight, according as it is increasing or decreasing, will give them reduced to the time of observation; or the proportional parts may be taken out by inspection from Table XLI. But, in general, it will be sufficiently exact to take them out for the nearest noon or midnight, without applying the proportional parts.

4. Add the difference between the Moon's augmented semidiameter and the dip to the observed altitude, if the lower limb be observed; or subtract their sum if the upper limb was taken; the sum, or remainder, will be the apparent altitude of the Moon's center.

5. Take out the correction from Table XXX. answering to the Moon's apparent altitude and horizontal parallax, and add it to the apparent altitude; the sum will be the true altitude of the Moon's center, which, subtracted from 90 degrees, will give the zenith distance, to be called north or south, according as the observer is north or south of the Moon; under this set the declination, taken from page VI. of the month in the Nautical Almanac, and reduced to the time at Greenwich by Table XVIII.† Now, the sum or difference of the zenith distance and declination, according as they are of the same or contrary names, will give the latitude of the place of observation, of the same name with the greater.

EXAMPLE I.

May 1, 1830, in longitude 84° E. the meridian altitude of the Moon's upper limb was 67° 36′ S. the height of the eye being 21 feet: required the latitude.

	h. m.
Moon's pass. over merid. Greenw.	7 46
Correction Table XVI. .	− 11
Moon's pass. over merid. Ship .	7 35
Longitude in time (XIX.) .	5 36 E.
Time at Greenwich . .	1 59
	° ′
Moon's declin. at noon .	10 5 N.
Moon's declin. at midn. .	8 25 N.
Variation in 12 hours	1 40
	° ′
Moon's declin. at noon .	10 5 N
Corr. for 1h.59m. Table XVIII.	− 17
Moon's reduced declination .	9 48 N.

Moon's hor. parallax at noon .		54′ 54″
		° ′
Obs. alt. Moon's upper limb .		67 36 S.
☽'s semid. at noon	14′ 58″	
Augmentation .	+ 15	
Moon's augm. semid.	15 13	− 20
Dip of horizon . .	4 23	
App. alt. of Moon's center .		67 16
Corr. Table XXX. . .		+ 21
True alt. of Moon's center .		67 37
		90
Zenith distance .		22 23 N.
Moon's declination . .		9 48 N.
Latitude		32 11 N.

EXAMPLE II.

July 11, 1830, in longitude 75° W. the meridian altitude of the Moon's lower limb was 55° 43′ N. the height of the eye being 18 feet: required the latitude.

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† When great accuracy is required, the declination should be reduced to the time at Greenwich, as directed in the explanation to Table XXXIV.; and that further corrected by the equation of second difference, as shewn in Explanation to Table XXXIX. but the latter correction is seldom necessary for the common purposes of navigation.

	h. m.
Moon's pass. over merid. Greenw.	17 5
Correction Table XVI. .	+ 11
Moon's pass. over merid. Ship .	17 16
Longitude in time (XIX.) .	5 0 W.
Time at Greenwich . .	22 16
	12
Ditto after midnight .	10 16
	° ′
Moon's declin. at midn. July 11 .	0 14 S.
Moon's declin. at noon, July 12 .	2 1 N.
Variation in 12 hours .	2 15
	° ′
Moon's declin. at midn. July 11 .	0 14 S.
Corr. for 10h. 16m. Table XVIII.	− 1 55
Moon's reduced declination .	1 41 N.

Moon's hor. par. at noon, July 12 .		59′ 10″
		° ′
Obs. alt. Moon's lower limb .		55 43 N
Moon's semid. at noon	16′ 7″	
Augmentation .	+ 13	
Moon's augm. semid.	16 20	+ 12
Dip of horizon .	4 4	
App. alt. of Moon's center .		55 55
Corr. Table XXX. . .		+ 32
True alt. of Moon's center .		56 27
		90
Zenith distance . .		33 33 S.
Moon's declination . .		1 41 N.
Latitude . . .		31 52 S.

EXAMPLE III.

November 9th, 1830, in longitude 11° East. the meridian altitude of the Moon's upper limb was 79° 56′ 45″ N the height of the eye being 18 feet, and the error of the Instrument 2′ 30″ to be added: required the latitude.

	h. m.	
Moon's pass. over merid. Greenw.	20 27	
Correction Table XVI. .	− 1	
Moon's pass. over merid. Ship .	20 26	
Longitude in time (XIX.) .	0 44 E.	
Greenwich time . .	19 42	
	12	
Ditto after midnight .	7 42	
	° ′ ″	
☽'s Dec. mid. 9th.	6 5 41 N.	
——noon, 10th.	4 12 14 N.	
		Const. L. 8.8239
Var. in 12 hours .	1 53 27 - P. L.	0.2005
Greenwich time 7h. 42m. -	P. L.	1.3688
	° ′ ″	
Var. in 7h. 42m.	1 12 47 - P. L.	0.3932
☽'s Dec. mid. 9th.	6 5 41 N.	
☽'s dec. Gr. time	4 52 54 N.	

Moon's reduced hor. parallax		54′ 47″
		° ′ ″
Obs. alt. Moon's upper limb .		79 56 45 N.
Index error . .		+ 2 30
Corr. obs. alt. Moon's up. limb		79 59 15
☽'s reduced semid.	14′ 55″	
Augmentation .	+ 15	
☽'s augm. semid.	15 10	− 19 14
Dip of horizon .	4 4	
App. alt. of Moon's center .		79 40 1
Corr. Table XXX. .		+ 9 40
True alt. of Moon's center .		79 49 41
		90
Zenith distance . .		10 10 19 S.
Moon's declination .		4 52 54 N.
Latitude . .		5 17 25 S.

To find the Latitude by a meridian Altitude below the Pole.

When the complement of the declination of an object is less than the latitude of a place, and they are both of the same name, the object comes to the opposite meridian without setting at that place, and in this case is said to be on the meridian below the Pole; if the altitude be then taken, the latitude may thence be found as follows:

Rule. Correct the observed altitude as before, and to the true altitude add the complement of the declination, (found by subtracting the declination from 90°:) the sum will be the latitude, of the same name with the declination.

EXAMPLE I.

June 29, 1830, the meridian altitude of the Sun's lower limb, at midnight, was 6° 30′, the height of the eye being 20 feet: required the latitude.

		°	′
Obs. alt. Sun's lower limb .		6	30
Semidiameter .	+ 16′	+	12
Dip of horizon .	− 4		
App. alt. Sun's center .		6	42
Refraction . .		−	8
True alt. of Sun's center .		6	34
Co. declination (Tab. X.)		66	44 N.
Latitude . . .		73	18 N.

EXAMPLE II.

May 10, 1830, about 10 o'clock in th evening, the altitude of the polar Star when on the meridian below the Pole, was 46° 30′; the height of the eye being 30 feet: required the latitude.

	°	′
Obs. alt. of Polar Star .	46	30
Dip of horizon . .	—	5
App. alt. of Polar Star .	46	25
Refraction . .	—	1
True altitude of Polar Star .	46	24
Co. declination (Table XIV.) .	1	36 N.
Latitude	48	0 N

To find the Latitude by an Altitude of the Polar Star.

Rule. To the Sun's right ascension, taken from Table XIV.* add the time since noon when the altitude was observed: their sum, (rejecting 24 hours, if it exceeds that quantity), will be the right ascension of the meridian, with which enter Table XIII.* and add the corresponding correction to, or subtract it from, the Star's true altitude, as directed in the Table; the sum or remainder will be the Latitude, always North.

EXAMPLE I.

May 21, 1830, the altitude of the Polar Star was observed to be 50°18′, at 10h.15m. past noon, the height of the eye being 20 feet: required the latitude.

		h.	m.
Sun's right ascension, May 21 .		3	51
Time of observation . .		10	15
Right ascension of meridian .		14	6
		°	′
Obs. alt. of Polar Star . .		50	18
Dip of the horizon .	— 4′	—	5
Refraction . .	— 1		
Star's true altitude .		50	13
Corr. from Tab. XIII.* to be added		1	32
Latitude		51	45

EXAMPLE II.

December 30, 1830, at 6h. 30m. past noon, the altitude of the Polar Star was 27° 36′. the height of the eye being 30 feet: required the latitude.

		h.	m.
Sun's right ascension, Dec. 30 .		18	37
Time of observation .		6	30
		25	7
Subtract . .		24	
Right ascension of meridian .		1	7
		°	′
Obs. alt. of Polar Star .		27	36
Dip of the horizon .	— 5′	—	7
Refraction .	— 2		
Star's true altitude . .		27	29
Corr. from Tab. XIII.* to be sub.		1	36
Latitude . .		25	53

The above method of finding the latitude by the polar Star is only an approximation, and may deviate two or three minutes from the truth; but, from its extreme simplicity, is well adapted to the practice of seamen, in cases where an error of a mile or two can be no material object; other methods have been given which require much calculation, and are therefore here omitted.

The nearer the Star is to the meridian, either above or below the pole, when the observation is made, the less will be the error in latitude, arising from an error in the supposed time. The time of the Star's passing the meridian may be easily obtained by consulting Table XV.; see also the explanation to that Table.

To find the Latitude by two observed Altitudes of the Sun, and the time elapsed between the observations; having also the Latitude by account, and the Sun's declination when the greater Altitude was taken.

Rule.—1. To the log. secant of the latitude by account (XXV.) add the log. secant of the Sun's declination; their sum, rejecting 20 from the index, call the *log. ratio.*

2. From the natural sine of the greater altitude (XXVI.) subtract the natural sine of the less altitude, and set the logarithm of their difference (XXIV.) under the log. ratio.

3. Take out the logarithm answering to half the elapsed time (XXVII.) and set it likewise under the log. ratio.

4. Add these three logarithms together, and find the middle time corresponding to the sum (XXVIII.) the difference between which, and the half elapsed time, will be the time from noon when the greater altitude was observed.

5. From the log. rising answering to this time (XXIX.) subtract the log. ratio, and the remainder will be the logarithm of a natural number (XXIV.;) which being found and added to the natural sine of the greater altitude, their sum will be the natural co. sine of the meridian zenith distance. (XXVI.)

6. Having the meridian zenith distance, the latitude is to be found in the usual manner.

7. If the latitude thus found differs considerably from the latitude by account, the operation is to be repeated, using the computed latitude instead of that by account, until the latitude last found agrees nearly with the latitude used in the computation*.

Remarks on the Times of Observation.

The observations must be taken between nine o'clock in the morning and three in the afternoon. If both observations be in the forenoon, or both in the afternoon, the elapsed time must not be less than the time from noon when the greater altitude is taken. If one observation be taken in the forenoon, and the other in the afternoon; the interval must not exceed four hours and a half, and in all cases the nearer the greater altitude is to noon the better.

If the Sun's meridian zenith distance be less than the latitude, the limitations are still more contracted. If the latitude be double the meridian zenith distance, the observation must be taken between half past nine in the forenoon, and half past two in the afternoon; and the interval must not exceed three hours and a half. The observations must be taken still nearer to noon, if the latitude exceed the meridian zenith distance in a greater proportion.

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* Dr. Brinkley, Professor of Astronomy in the University of Dublin, has published a set of Rules for solving this problem, which are annexed to the Nautical Almanac for the year 1822.

EXAMPLE I.

May 22, 1828, in latitude 41° 45′ N. by account, at 11h. 28m. in the forenoon, the true altitude of the Sun's center was 67° 16′, and at 12h 24m. 40s. it was 68° 24′: required the true latitude.

Times.	Altitudes.	Nat. Sines.	Lat. by acc. 41° 45′	Sec. 0.12723
11h 28m 0s	67° 16′	92231	Declination 20 26	Sec. 0.02822
12 24 40	68 24	92978		
			Log. ratio	0.15545
0 56 40		Diff. 747	Log.	2.87332
0 28 20 Half elapsed time			Log.	0.90899
0 9 55 Middle time			Log.	3.93776
0 18 25 Time from noon			Log. rising	2.50879
			Log. ratio	0.15545
Natural number		226	Log.	2.35334
Natural sine of greater alt.		92978		
Nat. co. sine of mer. zen. dist.		93204 = 21° 15′ N.		
	Declination	20 26 N.		
	Latitude	41 41 N.		

EXAMPLE II.

August 9, 1828, in latitude 50° 40′ N. by account, at 11h. 36m. 29s. in the forenoon, the altitude of the Sun's lower limb was 53° 18′; and at 1h. 13m. 53s. in the afternoon, its altitude was 51° 59′, the height of the eye being 26 feet: required the true latitude.

First observed altitnde		53° 18′	Second observed altitude		51° 59′
Semidiameter	+ 16′	+ 11	Semidiameter	+ 16	+ 11
Dip. of horizon	− 5		Dip. of horizon	− 5	
		53 29			52 10
Refraction		− 1	Refraction		− 1
True altitude		53 28	True altitnde		52 9

Times.	Altitudes.	Nat. Sines.	Lat. by acc. 50° 40′	Sec. 0.19803
12h 0m 0s	53° 28′	80351	Declination 15 50	Sec. 0.01680
11 36 29	52 9	78962		
			Log. ratio	0.21483
23 31		Diff. 1389	Log.	3.14270
1 13 53				
1 37 24 Elapsed time				
0 48 42 Half elapsed time			Log.	0.67592
0 12 23 Middle time			Log.	4.03345
0 36 19 Time from noon			Log. rising	3.09787
			Log. ratio	0.21483
Natural number		764	Log.	2.88304
Natural sine of greater alt.		80351		
Nat. co. sine of mer. zen. dist.		81115 = 35° 47′ N.		
	Declination	15 50 N.		
	Latitude	51 37 N		

As the latitude resulting from this computation differs 57′ from the latitude by account, the operation must be repeated, using the latitude last found, instead of the latitude by account.

Latitude last found	51° 37′	Sec.	0.20697
Declination	15 50	Sec.	0.01680
		Log. ratio	0.22377
Difference of Natural Sines	1389	Log.	3.14270
Half elapsed time	0h 48m 42s	Log.	0.67592
Middle time	0 12 38	Log.	4.04239
Time from noon	0 36 4	Log. rising	3.09187
		Log. ratio	0.22377
Natural number	738	Log.	2.86810
Nat. sine of greater alt.	80351		
Nat. co. sine of mer. zen. dist.	81089=35° 49′ N.		
Declination	15 50 N.		
Latitude	51 39 N.		

As this latitude differs only 2 miles from the latitude by the first operation, it may therefore be esteemed the true latitude.

In the preceding examples both observations were supposed to be taken in the same place; but as this is seldom the case, it will be necessary, when the ship is making much way, and the elapsed time is considerable, to correct the less altitude, in order to find what it would have been, had it been taken at the place where the greater altitude was observed; which is to be done as follows:

Let the bearing of the Sun be observed by compass, at the time of taking the less altitude, and find the number of points contained between that and the ship's course by compass, between the observations, corrected for leeway, if she makes any, which subtract from 16, when it is more than 8 points; likewise compute the distance run during the elapsed time: with these enter Table I. and find the corresponding difference of latitude, which will be the correction for the change of station.

If the less altitude be observed in the forenoon, the correction is to be added to it, if the above angle be less than 8 points; but when it is more, to be subtracted.

If the less altitude be observed in the afternoon, the correction is to be subtracted, if the angle is less than 8 points; but when greater, it is to be added to the less altitude.

The less altitude being thus corrected, proceed according to the rule, and the result will be the latitude of the ship when the greater altitude was observed.

EXAMPLE III.

November 10, 1829, latitude by account 32° 30′ N. at 9h. 30m. the altitude of the Sun's lower limb was 28° 14′, the bearing of its center by compass being S. E. ½ E.; and at 11h. 17m. 42s. the altitude of the upper limb was 39° 8′; the height of the eye being 18 feet, and the ship's course between the observations S. b. E. running 7 knots per hour; required the latitude of the ship at the time of the latter observation.

The elapsed time between the observations is nearly 1 hour 48 minutes, and her rate of sailing 7 miles per hour; therefore, as 1 hour : 7 miles : : 1h. 48m. : 12 miles, the distance run between the observations.

Sun's bearing at first observation S. E. ½ E. or S.	4½ Pts. E.
Ship's course during the elapsed time S.b.E. or S.	1 Pt. E.
Angle between them .	3½ Pts.

which being taken as a course, and the distance run during the elapsed time 12 miles, as a distance, give in the latitude column 9 miles nearly.

Obs. alt. Sun's lower limb .		28° 14′
Semidiameter .	+ 16′	+ 12
Dip . .	− 4	
		28 26
Refraction . . .		− 2
True altitude . . .		28 24
Corr. for Ship's way . .		+ 9
Reduced Altitude . .		28 33

Obs. alt. Sun's upper limb .		39° 8′
Semidiameter .	− 16′	− 20
Dip. . .	− 4	
		38 48
Refraction . .		− 1
True altitude . .		38 47

Times.	Altitudes.	Nat. Sines.			
9h 30m 0s .	28° 33′ .	47793	Lat. by acc.	32° 30′ Sec.	0.07397
11 17 42 .	38 47 .	62638	Declination	17 10 Sec.	0.01979
			Log. ratio . .		0.09376
1 47 42 Elapsed time		Diff. 14845	. Log. . .		4.17158
0 53 51 Half elapsed time .			. Log. .		0.63299
1 33 13 Middle time . . .			. Log. . .		4.89833
0 39 22 Time from noon .			Log. rising . .		3.16784
			Log. ratio . .		0.09376
Natural number .		1186	. . Log. .		3.07408
Natural sine of greater alt. .		62638			
Nat. co. sine of mer. zen. dist.		63824=50° 20′ N.			
	Declination	17 10 S.	. .	Sec.	0.01979
	Latitude	33 10 N.	.	Sec.	0.07723
			Log. ratio	.	0.09702
h m s Diff. Nat. Sines .		14845	. . Log.	.	4.17158
0 53 51 Half elapsed time .			. . Log.	.	0.63299
1 33 58 Middle time			. . Log.	.	4.90159
0 40 7 Time from noon . .			Log. rising	.	3.18411
			Log. ratio	.	0.09702
Natural number .		1222	. . . Log.	.	3.08709
Natural sine of greater alt. .		62638			
Nat. co. sine of mer. zen. dist.		63860=50° 19′ N.			
	Declination	17 10 S.			
	Latitude	33 9 N.			

EXAMPLE IV.

March 5, 1830, in latitude 60° 10′ N. by account, and longitude 160° W. the altitude of the Sun's lower limb was observed to be 19° 42′ at 10h. 4m. 20s. in the forenoon, his center bearing S. S. E. by compass, and at 1h. 32m. 36s. after noon it was 21° 8′. The ship's course during the elapsed time was N. W. b. N. sailing at the rate of 9 knots per hour, and the height of the eye 16 feet: required the latitude of the ship at the time of taking the greater altitude.

			°	′	″
Sun's bearing at 1st obs. S.S.E. = S. 2 pts. E.		Declination, March 5, 1830, .	6	7	20
Ship's course N.W.b.N. = S. 13 pts. W		Corr. for long. 160° W. .	—	10	8
		Corr. for time 1h 33m aft. n.	—	1	32
Angle between them .	15 pts.				
These subtracted from .	16	Reduced declination .	5	55	40

Leaves . . 1 point, which, taken as a course, and the distance **run** 31 **miles, give in the latitude column** 30 miles.

First observed altitude .		19° 42′	**Second observed altitude .**		21° 8′
Semidiameter .	+ 16′	+ 12	**Semidiameter .**	+ 16′	+ 12
Dip. of horizon .	— 4		**Dip. of horizon .**	— 4	
		19 54			21 20
Refraction . . .		— 3	**Refraction . .**		— 2
True altitude . . .		19 51	**True altitude .**		21 18
Corr. for Ship's way .		— 30			
Reduced altitude .		19 21			

Times.		Altitudes.	Nat. Sines.		
12h 0m 0s		19° 21′ .	33134	Lat. by acc. 60° 10′ .	Sec. 0.30323
10 4 20		21 18 .	36325	Declination 5 56 .	Sec. 0.00233
				Log. ratio	0.30556
1 55 40			Diff. 3191	. Log. .	3.50393
1 32 36					
3 28 16	Elapsed time				
1 44 8	Half elapsed time . . .			Log. .	0.35763
0 16 51	Middle time . .			Log. .	4.16712
1 27 17	Time from noon . . .			Log. rising .	3.85521
				Log. ratio .	0.30556
	Natural number .		3545 . . .	Log. .	3.54965
	Natural sine of greater alt. .		36325		
	Nat. co. sine of mer. zen. dist.		39870 = 66° 30′ N.		
	Declination		5 56 S. . .		Sec. 0.00233
	Latitude		60 34 N. . .		Sec. 0.30856
				Log. ratio .	0.31089
h m s	Diff. nat. sine 3191 . . .			Log. .	3.50393
1 44 8	Half elapsed time . . .			Log. . .	0.35763
0 17 4	Middle time			Log. . .	4.17245
1 27 4	Time from noon . .			Log. rising	3.85307
				Log. ratio .	0.31089
	Natural number .		3485 . .	Log.	3.54218
	Natural sine of greater alt. .		36325		
	Nat. co. sine of mer. zen. dist.		39810 = 66° 32½′ N		
	Declination		5 56 S.		
	Latitude		60 36½ N.		

EXAMPLE V.

May 7, 1830, in latitude 29° 10′ S. and longitude by account 110° 30′ E. at 4h. 59m. 20s. by a Chronometer, the observed altitude of the Sun's upper limb was 45° 33′; and at 5h. 54m. 45s. by tne same Chronometer, the observed altitude of his lower limb was 42° 8′ 30″, at which time it bore N. ¼ E. by compass, the ship's course between the observations was N. W. ¼ N. on the starboard tack, running at the rate of 6 knots per hour, and making 1 point leeway; the height of the eye being 22 feet, and the time at the meridian of the ship when the greater altitude was observed about 0h. 20m. P. M.: required the latitude of the ship when the first altitude was taken.

Ship's course by compass	N. 3¾ pts. W.
Leeway . .	1
Ship's course corrected	N. 4¾ W.
Sun's bearing .	N. 0¼ E.

		°	′	″
Sun's declination, May 7, by N. A.		16	44	56
Corr. for long 110° 30′ E. .	−		5	8
Corr. for time, 0h. 20m. P. M. .	+			16
Sun's reduced declination .		16	40	4

Angle between them . . 5 points, and the distance run 6 miles, give in the latitude column 3 miles.

		°	′	″
Obs. alt. Sun's upper limb .		45	33	0
Sun's semidiameter	−15′ 52″	−	20	22
Dip of horizon .	− 4 30			
App. alt. Sun's center .		45	12	38
Refraction . . .		−		57
Sun's true altitude . .		45	11	41

		°	′	″
Obs. alt. Sun's lower limb .		42	8	30
Sun's semidiameter .	+15′ 52″	+	11	22
Dip of horizon .	− 4 30			
App. alt. Sun's center .		42	19	52
Refraction . . .		−	1	3
Sun's true altitude . .		42	18	49
Corr. for Ship's way .		−	3	
Sun's reduced altitude .		42	15	49

Times by Chron.	Altitudes.	Nat. Sines.		
4h. 59m. 20s.	. 45° 12′ .	70957	Lat. by acc. 29° 10′	Sec. 0.05888
5 54 45	. 42 16 .	67258	Declination 16 40	Sec. 0.01864
			Log ratio .	0.07752
0 55 25	Diff.	3699	Log. .	3.56808
0 27 42	Half elapsed time		Log. .	0.91875
0 42 16	Middle time		Log. .	4.56435
0 14 34	Time from noon		Log rising .	2.30602
			Log ratio .	0.07752
	Natural number	169	Log. .	2.22850
	Natural sine of greater altitude	70957		
	Nat. co. sine mer. zen. dist.	71126 = 44° 40′ S.		
	Declination	16 40 N.		
	Latitude	28 0 S.		

By repeating the operation the latitude comes out the same as above.

A new and direct Method of finding the Latitude by two Altitudes of the Sun, the time elapsed between the observations, and the Sun's declination when the greater altitude was observed.[*]

Rule—1. Add together the true altitudes, and take half their sum; subtract the less altitude from the greater, and take half their difference.

2. Find the interval between the times of observing the two altitudes, which call *elapsed time;* take half of the elapsed time, and reduce it to degrees, &c. by Table XIX.

3. Add together the *co-secant* of half the elapsed time (reduced as above [†]) and the *secant* of the declination; their sum will be the *co-secant* of *arc first.*

4. Add together the *co-secant* of arc first, the *co-sine* of half the sum of the altitudes, and the *sine* of half their difference; the sum of these logarithms will be the *sine* of *arc second.*

5. Add together the *secant* of arc first, the *sine* of half the sum of the altitudes, the *co-sine* of half their difference, and the *secant* of arc second; their sum will be the *co-sine* of *arc third.*

6. Add together the *secant* of arc first (already found) and the *sine* of the declination; their sum will be the *co-sine* of *arc fourth*, when the latitude and declination are of the same name; but when they are of contrary names, take the supplement for *arc fourth.*

7. Take the sum or difference of arcs third and fourth, for *arc fifth.* (See Note.)

8. Add together the *secants* of arc second (already found) and arc fifth; their sum will be the *co-secant* of the *Latitude.*

Note. When the sum of arcs third and fourth is equal to, or greater than, 90°, their difference is always *arc fifth;* but when their sum is less than 90°, (which will rarely happen) it may be doubtful whether their sum or difference ought to be taken for *arc fifth.* But the computation is soon made on both suppositions, for the secant of arc fifth is the last logarithm which is taken from the Table, and the other parts of the calculation are therefore not affected by the change; one of the results must certainly be the required Latitude, and the latitude by account will generally be sufficient to determine which of them ought to be taken.

Remarks.

In this method the observations should, if possible, be taken under the same limitations as directed in the former (page 188); these however may, in case of necessity, be considerably extended, if the altitudes be taken with care, the elapsed time measured by a Chronometer, and the logarithms and arcs taken out to the nearest second.

In both the methods no allowance is made for the change of the Sun's declination during the interval between the observations; this indeed might be done; but the operation would be more complicated, while the omission will produce no error of consequence to the navigator, especially if the interval be not considerable.

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[*] This method of finding the Latitude by two Altitudes of the Sun, which is much simpler and more general than the former, was proposed by Mr. James Ivory, who has given an ingenious Solution of it in the Philosophical Magazine for August 1821. Mr. Riddle, of the Royal Naval Asylum, Greenwich, has since considerably improved Mr. I.'s Solution, and given a Rule, similar to the above, in the same work for September 1822.

[†] The Log of the half elapsed time may be taken from Table XXVII. which will save the trouble of reducing the time to degrees, &c.

It will much facilitate the operation if a formula be written out before the commencement of the calculation; and it should be observed, that many of the logarithms may be obtained at the same opening of the Table; thus, the secant and sine of the declination; the secant and co-secant of arc first; the former of which is wanted twice; the sines and co-sines of half the sum and difference of the altitudes; and the sine and secant of arc second; these being taken out together, will considerably expedite the calculation.

EXAMPLE I. (page 189.)

	Altitudes.		Times.			
	° ′		h. m. s.			° ′
	67 16		11 28 0	A. M.	Latitude by acc.	41 45 N.
	68 24		0 24 40	P. M.	Declination	20 26 N.
Sum	135 40	half 67° 50′	0 56 40	Elapsed time.		
Diff.	1 8	half 0 34	0 28 20	Half elapsed time = 7° 5′		

	° ′						
Half elapsed time	7 5	Co-secant	0.90899				
Sun's red. declin	20 26	Secant	0.02822			Sine	9.54297
Arc first	6 38	Co-secant	0.93721	Secant	0.00292	Secant	0.00292
Half sum alts.	67 50	Co-sine	9.57669	Sine	9.96665		
Half diff. alts.	0 34	Sine	7.99520	Co-sine	9.99998		
Arc second	1 51	Sine	8.50910	Secant	*0.00023		
Arc third	21 8			Co-sine	9.96978		
Arc fourth	69 25					Co-sine	9.54589
Arc fifth	48 17	Secant	0.17689				
		Secant	*0.00023				
Latitude	41 41	Co-secant	0.17712				

EXAMPLE II. (page 189.)

	Altitudes.		Times.			
	° ′		h. m. s.			° ′
	53 28		11 36 29	A. M.	Latitude by acc.	50 40 N.
	52 9		1 13 53	P. M.	Declination	15 50 N.
Sum	105 37	half 52° 48½′	1 37 24	Elapsed time.		
Diff.	1 19	half 0 39½	0 48 42	Half elapsed time 12° 10½′		

	° ′						
Half elapsed time	12 10½	Co-secant	0.67593				
Sun's red. declin.	15 50	Secant	0.01680			Sine	9.43591
Arc first	11 42½	Co-secant	0.69273	Secant	0.00913	Secant	0.00913
Half sum alts.	52 48½	Co-sine	9.78138	Sine	9.90125		
Half diff. alts.	0 39½	Sine	8.06031	Co-sine	9.99997		
Arc second	1 58	Sine	8.53442	Secant	*0.00026		
Arc third	35 31			Co-sine	9.91061		
Arc fourth	73 49					Co-sine	9.44504
Arc fifth	38 18	Secant	0.10525				
		Secant	*0.00026				
Latitude	51 39½	Co-secant	0.10551				

EXAMPLE III. (page 191.)

	Altitudes.		Times.			
	° ′		h. m. s.		Latitude by acc. .	32° 30 N.
	28 33		9 30 0	A. M.	Declination . . .	17 10 S.
	38 47		11 17 42	A. M.		
Sum .	67 20	half 33° 40′	1 47 42	Elapsed time.		
Diff. .	10 14	half 5 7	0 53 51	Half elapsed time = 13° 28′		

Half elapsed time	13° 28′	Co-secant	0.63287				
Sun's red. declin.	17 10	Secant .	0.01979			Sine .	9.47005
Arc first . . .	12 51	Co-secant	0.65266	Secant	0.01102	Secant	0.01102
Half sum alts. .	33 40	Co-sine .	9.92027	Sine .	9.74379		
Half diff. alts. .	5 7	Sine . .	8.95029	Co-sine	9.99827		
Arc second . .	19 30	Sine . .	9.52343	Secant	*0.02565		
Arc third . . .	53 4			Co-sine	9.77873		
Arc fourth .	107 37=(180°—72° 23′)					Co-sine	9.48107
Arc fifth . . .	54 33	Secant .	0.23658				
		Secant .	*0.02565				
Latitude . .	33° 9′N.	Co-secant	0.26223				

EXAMPLE IV. (page 192.)

	Altitudes.		Times.			
	° ′		h. m. s.		Latitude by acc. .	60° 10′ N.
	19 21		10 4 20	A. M.	Declination . . .	5 56 S.
	21 18		1 32 36	P. M.		
Sum .	40 39	half 20° 19½′	3 28 16	Elapsed time.		
Diff. .	1 57	half 0 58½	1 44 8	Half elapsed time = 26° 2′		

Half elapsed time	26° 2′	Co-secant	0.35764				
Sun's red. declin.	5 56	Secant .	0.00233			Sine .	9.01440
Arc first . . .	25 53	Co-secant	0.35997	Secant	0.04591	Secant	0.04591
Half sum alts.	20 19½	Co-sine .	9.97208	Sine .	9.54076		
Half diff. alts.	0 58½	Sine . .	8.23090	Co-sine	9.99994		
Arc second . .	2 6	Sine . .	8.56295	Secant	*0.00029		
Arc third . .	67 16			Co-sine	9.58690		
Arc fourth .	96 36=(180°—83° 24′)					Co-sine	9.06031
Arc fifth . .	29 20	Secant .	0.05959				
		Secant	*0.00029				
Latitude . .	60° 37′N.	Co-secant	0.05988				

Dr. Brinkiey's EXAMPLE III. in Nautical Almanac 1822, pages 11 and 12.

Latitude by acc. . 6° 30′ N.
Declination . . . 5° 30′ N.

	Altitudes. ° ′		Times. h. m. s.	
	70 1			
	35 21			
Sum	105 22	half 52° 41′	2 20 0	Elapsed time.
Diff.	34 40	half 17 20	1 10 0	Half elapsed time = 17° 30′

	° ′						
Half elapsed time	17 30	Co-secant	0.52186				
Sun's red. declin.	5 30	Secant	0.00200			Sine	8.98157
Arc first	17 25	Co-secant	0.52386	Secant	0.02038	Secant	0.02038
Half sum alts.	52 41	Co-sine	9.78263	Sine	9.90053		
Half diff. alts.	17 20	Sine	9.47412	Co-sine	9.97982		
Arc second	37 7	Sine	9.78061	Secant	*0.09832		
Arc third	3 47			Co-sine	9.99905		
Arc fourth	84 14					Co-sine	9.00195
Arc fifth	80 27	Secant	0.78013				
		Secant	*0.09832				
Latitude	7° 36′ N.	Co-secant	0.87845				
Arc fifth	88 1	Secant	1.46081				
		Secant	*0.09832				
Latitude	1° 35′ N.	Co-secant	1.55913				

The sum of the third and fourth arcs being less than 90°, this Example admits of two answers; first, by taking the difference of the arcs, the Latitude comes out 7° 36′; and by taking their sum, the Latitude will be 1° 35′; but it is evident that the former, agreeing nearly with the Latitude by account, will be the required Latitude.

Had this Example been worked to seconds the Latitudes would have been 7° 37′ 29″ and 1° 33′ 3″.

QUESTIONS FOR EXERCISE.

I. October 20, 1830, in latitude by account 50° 9′ N. at 0h. 34m. the Sun's true altitude was 29° 15′, and at 2h. 46m. it was 20° 3′: required the true Latitude.

Answer 50° 8′ N.

II. February 25, 1830, in latitude 49° 36′ N. by account, at 0h. 33m. P. M. the altitude of the Sun's lower limb was 28° 53′, and at 2h. 43m. P. M. it was 19° 44′, the height of the eye being 14 feet: required the true latitude.

Answer, 51°19′ North.

III. July 8, 1830, in latitude 58° 25′ N. by account, and longitude 138° E. at 11h. 2m. A. M. per watch, the altitude of the Sun's lower limb was 52° 53′, and at 1h. 25m. P. M. the altitude was 52° 44′, the Sun at that time bearing S. W. b. W. by compass; the height of the eye being 20 feet, and the ship's course during the elapsed time S. S. W. ½ W. sailing at the rate of 8 knots per hour: required the ship's true latitude at the time when the greater altitude was observed.

Answer, 57° 23′ North.

IV. August 30, 1830, in latitude 12° 43′ S. by account, and longitude 93° W. at 11h. 13m. 30s. A. M. the altitude of the Sun's lower limb was 66° 9′ 30″, and at 1h. 15m. 12s. P. M. it was 62° 0′ 15″, bearing at that time N. W. ½ W.: during the elapsed time the ship was sailing S. W. b. W. at the rate of 4 knots per hour, and the height of the observer's eye was 28 feet: required the latitude at the time of taking the first altitude.

Answer, 11° 37′ South.

To find the Latitude by an Altitude of the Sun taken near the Meridian; having the apparent Time from Noon, the Latitude by Account, and the Declination.*

Rule—1. Correct the Sun's observed altitude, and reduce the declination, taken from page II. of the month in the Nautical Almanac, to the time of observation.

2. Add together the log. rising of the time from noon (XXIX.)
the log. co. sine of the latitude (XXV.)
and the log. co. sine of the declination;

the natural number corresponding to the sum of these three logarithms (rejecting the tens in the index) (XXIV.) being found and added to the natural sine (XXVI.) of the true altitude, will give the natural cosine of the meridian zenith distance, to which apply the declination as before, and the result will be the latitude.

Note. The apparent time should be corrected for the longitude made since the error of the watch, from which the time is inferred, was ascertained; by adding thereto the difference of longitude (reduced into time by Table XIX.) if east, or subtracting it if west.

EXAMPLE I.

October 10, 1830, in latitude by account 46° 10′ N. and longitude 171° W., the altitude of the Sun's lower limb was 36° 33, at 0h. 28m. 10s, after noon, by a watch previously regulated, and the height of the eye was 17 feet: required the latitude.

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* In this method of finding the Latitude the time from noon should not exceed 30 minutes

Obs. alt. Sun's lower limb .		36°	33′
Semidiameter	. +16′	+	12
Dip of horizon .	− 4		
		36	45
Refraction . .		−	1
Sun's true altitude .		36	44

Sun's dec. Oct. 10 .		6°	33′	15″ S
Corr. for long 171° W.	+		10	51
Corr. for time 28m. aft.n.	+			27
Reduced declination .		6	44	33

Time from noon	$0^h\ 28^m\ 10^s$	Rising .	2.87753
Latitude by acc.	46° 10′ . .	Co. sine .	9.84046
Declination	6 44½ . .	Co. sine .	9.99699
		Nat. number 519 Log. .	2.71498
True altitude .	36 44 .	Nat. siue 59809	
Mer. zen. dist.	52 54 .	Nat. co. sine 60328	
Declination .	6 44½S.		
Latitude .	46 9½N.		

EXAMPLE II.

July 3, 1830, in latitude by account 27° 50′ S. and longitude 33° W, at 11h. 48m. 40s., A. M. by a watch whose error was previously found to be 7m. 30s. too fast*, the altitude of the Sun's upper limb was 41° 2′; the height of the eye being 21 feet, and the ship having made 38 miles of longitude to the eastward since the watch was regulated: required the latitude of the place of observation.

Time of observation per watch .	11^h	48^m	40^s	
Watch too fast . . .	−	7	30	
Time corrected for the error of watch .	11	41	10	
Longitude made, in time (XIX.) .	+	2	32	E.
The time of observation after midnight	11	43	42	
	12	0	0	
Ditto before noon July 3 .	0	16	18	

Obs. alt. Sun's upper limb .		41°	2′
Semidiameter	. − 16′	−	20
Dip of horizon	. − 4		
		40	42
Refraction .		−	1
Sun's true altitude .		40	41

Sun's declination, July 3		23°	0′	19″
Corr. for long. 33° W.	−		0	27
Corr. for time 16m. bef. n.	+			2
Reduced declination		22	59	54

Time from noon .	$0^h\ 16^m\ 18^s$.	Rising .	2.40266
Latitude by acc.	27° 50′ .	Co. sine .	9.94660
Declination .	23 0 .	Co. sine .	9.96403
		Nat. number 206 Log. .	2.31329
True altitude .	40 41	Nat. sine 65188	
Mer. zen. dist.	49 9½ .	Nat. co. sine 65394	
Declination .	23 0 N.		
Latitude . .	26 9½ S.		

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* See the Rules for finding the Time and Error of the Watch further on.

OF THE

VARIATION OF THE COMPASS.

THE VARIATION OF THE COMPASS is the deviation of the points of the Mariner's Compass from the corresponding points of the Horizon, and is termed *east* or *west* Variation, according as the magnetic needle, or north point of the Compass, is inclined to the eastward or westward of the true north point of the horizon.

For many years after the discovery of the compass, it was supposed that the needle exactly coincided with the plane of the meridian, and consequently that all the points of the compass agreed with the correspondent points of the Horizon. In the year 1492, Columbus first observed that the needle deviated from the north and south points of the Horizon, but still imagined this deviation was constantly the same: however, in 1634, Mr. Edward Gillibrand, Professor of Astronomy in Gresham College, discovered, from a comparison of his own observations with those of his predecessors, that the variation was not always the same at the same place; for in that year, he found that the variation of the compass, at Deptford, was 4° 4′ east, which, compared with the same as observed by Mr. Burrows, in 1580, at Limehouse, who had found it to be 11° 15′ E., plainly shewed, that in the course of 54 years the variation had diminished more than 7 degrees; in 1657, according to Mr. Bond's observations, there was no variation of the compass at London; since that time the needle has been declining westward, and is at present about 24° 36′ West.*

It likewise appears, from observations made in various parts of the world, that in different places the variation differs both as to its quantity and denomination, being west in some places, and east in others: thus, off the south coast of Ireland the variation is at present about 30° West, but near Cape Horn, in South America, it is 22° East.

But besides the deviation of the needle from the plane of the true meridian, which it acquires after being touched with a magnet, it obtains another property called the *dip;* that is, although the needle be properly balanced beforehand, it will now lose its horizontal position, and one end will incline below the horizon while the other will be elevated, so that it will be necessary to attach a weight to the elevated end in order to restore it to a horizontal position when supported on the central pin; the angle that it makes with the horizon is called the *dip of the needle;* near the equator it inclines but little from the horizontal plane, but one end is depressed the more as we advance towards the poles, the north end in the northern hemisphere, and the south end in the southern hemisphere.

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* According to the accurate observations of Colonel Beaufoy, made near London, the variation of the needle had arrived at its maximum in March 1819, when it was at noon 24° 41′ 42″ West; the Needle has since that time been retrograding, the magnetic north gradually inclining to the eastward, and consequently the westerly variation decreasing.

The Needle is also subject to a *local attraction*, resulting principally from the masses of iron on board ship, by which it will be drawn more or less from the magnetic meridian according as the disturbing cause is situated with regard to the needle; this effect is called the *abberration of the needle.* Now, as a ship in traversing is constantly changing its direction, the iron contained therein must be carried by it into different positions with respect to the compass, and by its attraction will continually change the direction of the needle. If westerly variation be increased, or easterly variation diminished, when the ship's head is in a westerly direction, the contrary effect will be produced when the ship's head is brought round to an easterly direction, that is, westerly variation will be diminished, and easterly increased; hence it will be necessary to determine the actual variation of the compass when the ship's head is directed to different points of the horizon. In the northern hemisphere, when the compass is placed at or near the binnacle, the north point of the needle is attracted or drawn forward towards the ship's head, and the south point in the southern hemisphere.

The greatest abberration takes place when the ship's head is at or near the east or west points, and decreases towards the magnetic meridian, in the proportion of radius to the sine of the angle between the ship's head and the magnetic meridian.

The most simple method of ascertaining the abberration, and from thence the actual variation of the compass, when the ship's head is in any given direction, is to observe the variation when the ship's head is brought alternately to the east and west points; half the sum of these variations will be the true variation, and half the difference will be the greatest abberration of the needle, arising from local attraction; then to find the abberration, and from thence the actual variation, when the ship's head is on any other point of the compass, enter a Traverse Table with the given number of points from North or South at the top or bottom, and the greatest abberration, reduced to minutes, in a distance column; opposite to which, in the corresponding departure column, will be found the abberration in minutes, when the ship's head is on the given point of the compass; then if the ship be in the northern hemisphere allow the abberration to the right hand of the true variation, when the given point is to the eastward of the magnetic meridian, or to the left hand when the given point is to the westward; but the contrary to this rule is to be observed when the ship is in the southern hemisphere: the result will give the actual variation when the ship's head is on the given point of the compass.

Example. Suppose when the Ship's head bore East, being in north latitude, the observed variation was 21° 30′ W., but when the Ship's head was put about to West, the observed variation was 27° 30′ W.: required the true variation independant of local attraction, the greatest abberration of the needle, and the actual variation when the ship's head is on each second point of the compass.

Variation with Ship's head East	21° 30′ W.		21° 30′ W.
Variation with Ship's head West	27 30 W.		27 30 W.
	2) 49 0		2) 6 0
True variation	24 30	Greatest abberration	3 0=180′

Now to find the abberration of the needle when the Ship's head is two points from the North or South, enter Table I. with two points at the top, and the greatest abberration 180′ in a distance column, opposite to which, in the corresponding departure column, will be 69 = 1° 9′, the abberration required; this abberration being allowed to the right hand when the ship's head is to the eastward, diminishes the true variation 24° 30′ W. and therefore subtracted from it leaves 23° 21′, the variation to be allowed when the ship's head is N. N. E. or S. S. E.; but as the abberration is to be allowed to the left hand when the ship's head is to the westward, consequently increasing the variation, add the above together and their sum 25° 39′ will be the variation when the ship's head is N. N. W. or S. S. W.

In the same manner the variations may be found corresponding to the other points of the compass.

The variations may then be formed into a table as follows:

Ship's head by Compass.	Variations.	Ship's head by Compass.	Variations.
North	24° 30′ W.	South	24° 30′ W.
N. N. E.	23 21	S. S. W.	25 39
N. E.	22 23	S. W.	26 37
E. N. E.	21 44	W. S. W.	27 16
East	21 30	West	27 30
E. S. E.	21 44	W. N. W.	27 16
S. E.	22 23	N. W.	26 37
S. S. E.	23 21	N. N. W.	25 39

Hence the variations to be allowed are opposite the courses steered; thus, if the ship's head is E. N. E. the variation to be allowed is 21° 44′ W., but if W. S. W. the variation to be allowed is 27° 16′ W.

The observations for determining the variation should be made with an azimuth compass placed amidship on, or as near to, the binnacle as can be safely done, and the steering compass should be compared with the azimuth compass to ascertain that there is no difference in the direction of the needles, since the local attraction of the iron in the ship will affect the needle differently in different parts of it.

The VARIATION OF THE COMPASS is found by comparing together the Sun's true and magnetic amplitudes or azimuths.

The TRUE AMPLITUDE of any celestial object is an arch of the Horizon contained between the true east or west points thereof, and the center of the object at the time of its rising or setting; or it is the degrees and minutes, the object rises or sets to the northward or southward of the true east or west points of the Horizon.

The MAGNETIC AMPLITUDE, is an arch contained between the east or west points of the Compass and the center of the object at rising or setting: or it is the bearing of the object, by Compass, when in the Horizon.

The TRUE AZIMUTH of an object is an arch of the Horizon contained between the true meridian and the azimuth circle passing through the center of the object.

The MAGNETIC AZIMUTH, is an arch contained between the magnetic meridian and the azimuth circle passing through the center of the object; or it is the bearing of the object, by compass, at any time when it is above the Horizon.

The true amplitude, or azimuth, is found by calculation, and the magnetic amplitude, or azimuth, by an azimuth compass.

The following is a description of Mr. M'Culloch's patent azimuth compass, with the method of observing amplitudes, or azimuths, by the same.

DESCRIPTION OF THE AZIMUTH COMPASS.

Figure 2, Plate VIII., is a representation of the azimuth compass ready for observation. The needle in this compass is bent in such a manner that the point of the conical pivot, on which it moves and is supported, may be brought very near to the center of gravity, as well as to the center of motion. The card is similar to those of the steering compass, with this difference only, that a circular ring of silvered brass, divided into 360°, or rather, into four times 90°, circumscribes the card; *b* represents the compass box, which is brass, and has a hollow conical bottom: *e* is the prop upon which the compass is supported instead of gimbols: it stands in a brass socket screwed to the bottom of the wooden box, and may be turned round at pleasure: *h* is one of the guards; the other being directly opposite, is hid by the box. Each guard has a slit, in which a pin, projecting from the side of the box, may move freely in a vertical direction: 1 is a brass bar, upon which, at right angles, the sight-vanes are fixed: a line is drawn along the middle of this bar; which line, the lines in the vanes, and the thread joining their tops, are all in the same plane: 2 is a coloured glass, which may be moved up or down the sight-vane 3; 4 is a magnifying glass moveable on the other vane, whose focal distance is nearly equal to the distance between the vanes: 5 is the nonius, or vernier, which contains six divisions, and as the limb of the card is divided into half degrees, each division of the nonius is therefore five minutes. The interior surface of the nonius is ground concave to the segment of a circle of the same diameter as the circle of the card: 6 is a stopper, or screw, connected with the nonius, which serves to move the nonius close to the card, and thereby prevent it from vibrating as soon as the observation of the amplitude, or azimuth, is completed: 7 is a convex lens to assist the eye in reading off the observed amplitude, or azimuth: 8 is a milled head by which the card may be lifted off the center, and prevented from vibrating when the compass is not wanted for use.

USE OF THE AZIMUTH COMPASS.

To observe the Sun's Amplitude.

Turn the compass-box until the vane containing the magnifying-glass is directed towards the Sun; and when the bright speck, or rays of the Sun collected by the magnifying-glass, falls upon the slit in the other vane, stop the card by means of the nonius, and read off the amplitude.

Without using the magnifying-glass, the sight may be directed through the dark glass towards the Sun; and in this case, the card is to be stopped when the Sun is bisected by the thread in the other vane.

The observation should be made when the Sun's lower limb appears somewhat more than his semidiameter above the Horizon, because his center is really then in the Horizon, although it is apparently elevated on account of the refraction of the atmosphere: this is particularly to be noticed in high latitudes.

To observe the Sun's Azimuth.

Raise the magnifying-glass to the upper part of the vane, and move the box, as before directed, until the bright speck fall on the other vane, or on the line in the horizontal bar; the card is then to be stopped, and the divisions being read off, will be the Sun's magnetic azimuth.

If the card vibrate considerably at the time of observation, it will be better to observe the extreme vibrations, and take their mean as the magnetic azimuth. When the magnetic azimuth is observed, the altitude of the object must be taken, in order to obtain the true azimuth.

It will conduce much to accuracy if several azimuths be observed, with the corresponding altitudes, and the mean of the whole taken for the observation.

To find the Variation of the Compass by an Amplitude.

Rule.—1. To the log. secant of the latitude of the ship, rejecting the index (XXV.,) add the log. sine of the Sun's declination (X.,) corrected for the time and place of observation (XXI.;) their sum will be the log. sine of the true amplitude*, to be reckoned from the east in the morning, or the west in the afternoon, towards the north or south, according to the declination.

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* The true amplitude may likewise be found by Table XII.

2. Then if the true and magnetic amplitudes be both north or both south, their difference is the variation: but if one be north and the other south, their sum is the variation: and to know whether it be easterly or westerly, suppose the observer looking towards that point of the compass representing the magnetic amplitude; then if the true amplitude be to the right hand of the magnetic, the variation is east, but if to the left hand, it is west.

EXAMPLE I.

Required the Sun's true amplitude on November 6, 1828, in latitude 48° 21′.

Latitude	48° 21′	Secant	0.17745
Declination	16 4 S.	Sine	9.44210
True amplitude	24 37	Sine	9.61955

Hence the Sun will rise E. 24° 37′ S. or E. S. E. ¼ S. nearly, and set W. 24° 37′ S. or W. S. W. ¼ S. nearly.

EXAMPLE II.

July 3, 1828, in latitude 9° 36′ S. the Sun was observed to rise E. 12° 42′ N.: required the variation of the compass.

Latitude	9° 36′ S.	Secant	0.00613
Declination	22 58 N.	Sine	9.59128
True amplitude	E. 23 19 N.	Sine	9.59741
Mag. amplitude	E. 12 42 N.		
Variation	10 37		

Variation 10 37 west, because the true amplitude is to the left of the magnetic.

EXAMPLE III.

September 24, 1828, in latitude 26° 32′ N., and longitude 43° W., the Sun's center was observed to set W. 6° 15′ S. about 6h. P. M. required the variation of the compass.

Sun's declination (Table X.)	0° 33′ S.		
Corr. for long. 43° W. (Table XXI.)	+ 3		
Corr. for time 6h. P. M.	+ 6		
Reduced declination	0 42 S.	Sine	8.08696
Latitude	26 32	Secant	0.04834
True amplitude	W. 0 47 S.	Sine	8.13530
Mag. amplitude	W. 6 15 S.		
Variation	5 28		

Variation 5 28 East, because the true amplitude is to the right of the magnetic.

EXAMPLE IV

Being at sea in latitude 43° 36′ N. and longitude 20° west, on February 15, 1828, I observed the Sun's center at setting, W. 5° 45′ N. about 7 o'clock in the evening: required the variation of the compass.

Sun's declination (Table X.) .		12°	54	S.		
Corr. for long. 20°W.(Table XXI.)		—	1			
Corr. for time 7h. P. M. . .		—	6			
Reduced declination .		12	47		. . . Sine	9.34491
Latitude . .		43	36		. . . Secant	0.14016
True amplitude .	W.	17	47	S.	. . Sine	9.48507
Mag. amplitude .	W.	5	45	N.		
Variation		23	32	west, because the true amplitude is to the left of the magnetic.		

To find the Variation of the Compass by an Azimuth.

Rule.—1. Reduce the Sun's declination (X.) to the time and place of observation (XXI.) and compute the true altitude of the Sun's center. (IV. V.)

2. Subtract the Sun's declination from 90°, when the latitude and declination are of the same name, or add it to 90°, when they are of contrary names; and the sum, or remainder, will be the Sun's polar distance.

3. Add together the Sun's polar distance, the latitude of the ship, and the altitude of the Sun; take the difference between half their sum and the polar distance, and note the remainder;

4. Then add together,

the log. secant of the altitude (XXV.) } rejecting their indices
the log. secant of the latitude - }
the log. co-sine of the half sum,
and the log. co-sine of the remainder.

5. Half the sum of these four logarithms will be the sine of an arch, which doubled, will be the Sun's true azimuth; to be reckoned from the south in north latitude, and from the north in south latitude; towards the east in the morning, and towards the west in the afternoon.

6. Then if the true and observed azimuths be both reckoned from the north, or both from the south, their difference is the variation; but if one be reckoned from the north, and the other from the south, subtract the true azimuth from 180°, and the difference between the remainder and the magnetic azimuth will be the variation; and to know if it be east or west, suppose the observer looking towards that point of the compass representing the magnetic azimuth: then if the true azimuth be to the right of the magnetic, the variation is east, but if the true be to the left of the magnetic the variation is west.

EXAMPLE I.

July 20, 1829, in latitude 31° 42′ N. and longitude 32° E. about 7 o'clock in the morning, the Sun's azimuth by the compass was observed to be S. 83° 45′ E. at the same time that the altitude of his lower limb was 23° 36′; the height of the eye being 24 feet: required the variation of the compass.

Sun's declin. July 20, at noon -	20° 42′ N.	Obs. alt. Sun's lower limb -		23° 36′
Corr. for long. 32° E. .	+ 1	Semidiameter -	16′	+ 11
Corr. for time 5h. before noon. .	+ 2	Dip. . -	5	
Reduced declination -	20 45			23 47
	90 00	Refraction -		— 2
Polar distance -	69 15	True altitude - -		23 45
Altitude - -	23 45	- Secant	0.03843	
Latitude - -	31 42	- Secant	0.07017	
Sum - -	124 42			
Half - -	62 21	- Co. sine	9.66658	
Remainder -	6 54	- Co. sine	9.99684	
			19.77202	
	50 17	- Sine	9.88601	
	2			
True azimuth	S. 100 34 E.			
Mag. azimuth	S. 83 45 E.			

Variation - 16 49, or 1½ point west, because the true azimuth is to the left of the magnetic.

EXAMPLE II.

November 2, 1828, in latitude 25° 32′ N and longitude 40° W. the altitude of the Sun's lower limb was observed to be 15° 36′, about 4h. 10m. P. M., his magnetic azimuth at that time being S. 58° 32′ W. and the height of the eye 18 feet: required the variation of the compass.

Sun's declin. Nov. 2, at noon	14° 51′ S.	Obs. alt Sun's lower limb		15° 36′
Corr. for long. 40° W. -	+ 2	Semidiameter -	16′	+ 12
Corr. for time 4h. 10m. aft. n.	+ 3	Dip - -	4	
Reduced declination -	14 56			15 48
	90 00	Refraction - -		— 3
Polar distance	104 56	True altitude - -		15 45
Altitude -	15 45	- Secant	0.01662	
Latitude -	25 32	- Secant	0.04463	
Sum - -	146 13			
Half -	73 6	Co. Sine	9.46345	
Remainder -	31 50	- Co. Sine	9.92921	
			19.45391	
	32 14	- Sine	9.72695	
	2			
True azimuth	S. 64 28 W.			
Mag. azimuth	S. 58 32 W.			

Variation - 5 56 east, because the true azimuth is to the right of the magnetic.

EXAMPLE III.

February 14, 1830, in latitude 36° 18 S. and longitude 109° 9′W, about half past 6 A. M. the following altitudes of the Sun's lower limb, with the corresponding azimuths, were observed; the height of the eye being 30 feet: required the variation of the compass.

Azimuths.	Altitudes.
S. 87° 15′ E.	11° 15′
87 0	11 52
86 40	12 44
86 10	13 17
85 45	13 50
5) 432 50	62 58
Means S. 86 34 E.	12 35

		° ′
Obs. alt. ☉'s l. l.		12 35
Semid.	16′	+ 11
Dip. -	5	
		12 46
Refraction -		− 4
True alt. -		12 42

	° ′
Sun's declin. Feb. 14 -	13 5
Corr. for long. 109° W.	− 6
Corr. for time 5½h. bef. n.	+ 5
Reduced declination -	13 4

		°	′			
		90°	00′			
Declination -		13	4			
Polar distance -		76	56			
Altitude -		12	42	-	Secant	0.01076
Latitude - -		36	18	-	Secant	0.09370
Sum - -		125	56			
Half -		62	58	-	Co. sine	9.65754
Remainder		13	58	-	Co. sine	9.98697
						19.74897
		48	30	-	Sine	9.87448
			2			
True azimuth	N.	97	0 E.			
		180	0			
	Or, S.	83	0 E.			
Mag. azimuth	S.	86	34 E.			
Variation -		3	34 E.			

To find the Sun's true Azimuth by another Method.

RULE 1.—Add together the latitude of the ship and the altitude of the Sun; and to the natural co. sine of their sum, add the natural sine of the Sun's declination, (XXVI.) when the latitude and declination are of the same name, otherwise take their difference.

If the sum of the latitude and altitude exceed 90°, subtract 90° from it, and find the difference of the natural sine of the remainder, and the natural sine of the Sun's declination.

2. To the logarithm of the above sum or difference (XXIV.) add the secant of the latitude, and the secant of the altitude, (XXV.) rejecting their indices: their sum will be the log. rising of an angle in hours, minutes, and seconds; (XXIX.) which being turned into degrees and minutes (XIX.) will be the Sun's true azimuth: to be reckoned from the south in north latitude, and from the north in south latitude, towards the east in the morning, and towards the west in the afternoon.

EXAMPLE I.

Required the Sun's true azimuth in latitude 31° 42′ N. when his altitude is 23° 45′, and his declination 20° 45′ N.

Latitude	31°	42′ N.			Secant	0.07017
Altitude	23	45			Secant	0.03843
Sum	55	27	Nat co. sine	56713		
Declination	20	45 N.	Nat. sine	35429		
			Sum	92142	Log	4.96454

5.07314 Log. rising of $6^h\ 42^m\ 20^s$ equal to 100° 35′, the Sun's azimuth from the south; the same within one minute as the first Example worked by the former method.

EXAMPLE II.

What is the Sun's true azimuth in latitude 25° 32′ N., when his true altitude is 15° 45′, and declination 14° 56′ S.?

Latitude	25°	32′ N.			Secant	0.04463
Altitude	15	45			Secant	0.01662
Sum	41	17	Nat. co. sine	75146		
Declination	14	56 S.	Nat. sine	25770		
			Diff.	49376	Log	4.69352

4.75477 Log rising of $4^h\ 17^m\ 46^s$ equal to 64° 27′, the Sun's true azimuth from the south; the same as the second Example in the former method within one minute.

EXAMPLE III.

Required the Sun's true azimuth in latitude 51° 31′ S. when his true altitude is 46° 28′, and his declination 22° 17 S.

Latitude	51°	31′ S:			Secant	0.20601
Altitude	46	28			Secant	0.16192
Sum	97	59				
	90	00				
Remainder	7	59	Nat. sine	13889		
Declination	22	17 S.	Nat. sine	37919		
			Diff.	24030	Log	4.38075

4.74868 Log. rising of $4^h\ 15^m\ 50^s$ equal to 63° 57′, the Sun's true azimuth from the North.

# *DESCRIPTION AND USE*

OF

HADLEY'S SEXTANT

THIS Instrument is constructed on the same principles as the Quadrant, but as it is used to measure the *angular* distance between the Moon and the Sun, or a Star, in order to determine the longitude, the Arch is extended to 120 degrees, for the purpose of measuring their distance when greater than 90 degrees; it is also provided with some appendages not commonly annexed to a quadrant, in order to take the observation with greater accuracy; which will be described in the following pages.

Fig. I. Plate IX. represents a Sextant, the frame of which is sometimes made of ebony, but generally of brass, or other hard metal. The Arch AA is, on the common instruments, made of ivory, and divided into 120 degrees, each degree into 3 parts, of course equal to 20 minutes, which is again subdivided by the Nonius into half-minutes or 30 seconds; each second division, or minute, on the Nonius, being cut longer than the intermediate ones. The Nonius is numbered at every fifth of these longer divisions, from the right towards the left, with 5, 10, 15, and 20, the first division towards the right-hand, marked 0, being called the ***Index division***.

But the best Sextants, which have silver or platina Arches, are usually divided to quarter minutes, in which case the degrees on the Arch are divided into 4 parts, or 15 minutes, and the minutes on the Nonius into the like number, each equal to 15 seconds.

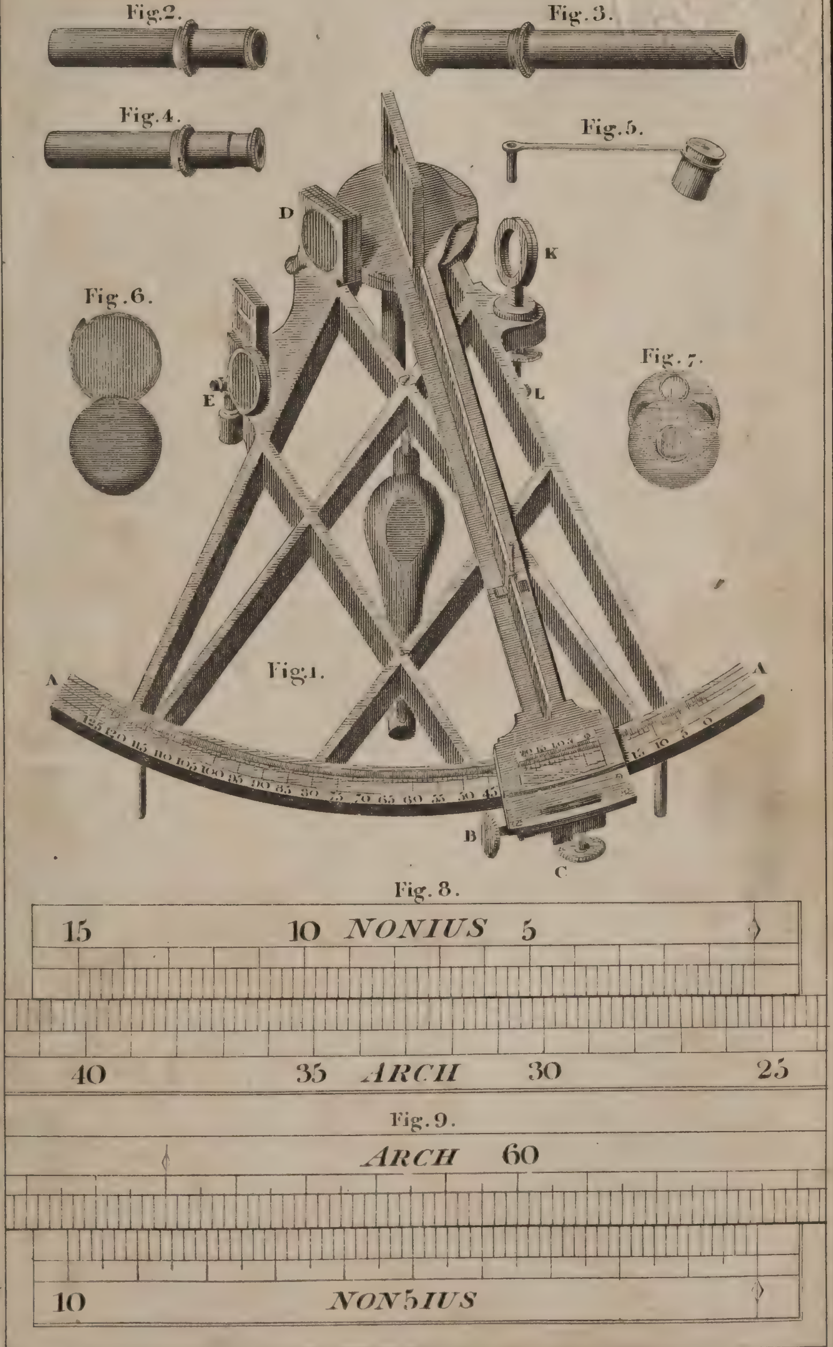
On some Sextants the degrees are divided into six equal parts, each representing 10 minutes, and the minutes on the Nonius also into six parts or 10 seconds each. The Nonius is sometimes placed above and sometimes below the Arch.

Figure 8 represents part of the Arch of a Sextant, the degrees of which are divided into 4 equal parts, and the minutes of the Nonius scale into the like number. In this Figure, the Index division, or 0 of the Nonius, which is placed above the Arch, stands between 25° 15′ and 25° 30′ on the Arch; and that division of the Nonius exactly coinciding with one on the Arch, is the second or 30″ to the left of 7 minutes, or 7′ 30″, therefore the whole extent between the Index division and the 0 on the Arch is 25° 22′ 30″.

Again, in Figure 9, where the Nonius is below the Arch, the 0 on the Nonius is somewhat more than three divisions or 30′ to the left of 56°, and the division on the Nonius coinciding with one on the Arch, is 4′, therefore the Angle pointed out by the Index division is 56° 34′.

When the Index division is to the right of 0 in the Arch, or as it is

HADLEY'S SEXTANT.



J. Norie delin.t   Stephenson sc.

called on the *arch of excess*, the divisions are to be counted from left to right, both on the Arch and on the Nonius; thus suppose on an instrument divided as in Figure 8, the 0 on the Nonius was rather more than three divisions to the right of 0 on the Arch, and that the third long division on the Nonius (representing minutes) from the left, marked 15, coincided exactly with a division on the Arch; then the whole Arch would be 48 minutes, that is 45 minutes on the Arch of excess, and 3 minutes on the Nonius.

Or if the 0 on the Nonius of a Sextant divided as in Figure 9, were placed between the third and fourth divisions to the right of 0 on the Arch, and the fifth subdivision on the Nonius, counting to the right from that marked 10, coincided with one on the Arch, the whole Arch would be 30 minutes and 50 seconds.

In order to observe with accuracy, and make the images come precisely in contact, an adjusting, or *tangent screw* B, is added to the Index, by which it may be moved with greater regularity than it can oe by hand; but it must be observed this screw does not act until the Index is fixed by the finger screw C, placed at the back of the Sextant. Care should be taken not to force the tangent screw when it arrives at either extremity of its Arch. When the Index is to be moved any considerable quantity, the screw C must be loosened; but when the Index is brought nearly to the division required, this back screw should be tightened, and then the Index be moved gradually by the tangent screw.

Four shades or coloured glasses are placed at D, between the Index and horizon glasses, each of which is set in a different frame turning on a center: they are used to screen the eye from the brightness of the reflected solar image, and the glare of the moon, and may be used separately, or together, as occasion requires.

Three more such glasses are placed behind the horizon glass at E, to weaken the rays of the Sun or Moon when they are viewed directly through the horizon glass. The pale glass is sometimes used in observing altitudes at sea, to take off the strong glare of the horizon.

The Sextant is generally furnished with a plane tube (Fig. 2.) without any glasses; and to render the objects still more distinct, it has likewise two telescopes, one representing the objects *erect*, or in their natural position, (Fig. 4.); the other a longer one (Fig. 3.) which shews the objects *inverted;* but the latter has a larger field of view, and a greater magnifying power, with other advantages; a little use will soon accustom the observer to the inverted position, and the instrument will be as readily managed by it as the plane tube alone. By a telescope the contact of the images is more perfectly distinguished; and by the place of the images in the field of the telescope, it is easy to perceive whether the Sextant is held in the proper plane for observation. By sliding the tube that contains the eye-glasses in the inside of the other tube, the object is suited to different eyes, and made to appear perfectly distinct and well defined.

The telescope is to be screwed into a circular ring at K; this ring rests on two points against an exterior ring, and is held thereto by two screws: by turning one, and tightening the other, the axis of the telescope may be set parallel to the plane of the Sextant. The exterior ring is fixed on a brass stem that slides into a socket; and by means of the screw L, at the back of the Sextant, it may be raised or lowered sc as to move the center of the telescope to point to that part of the horizon-glass which shall be judged the most fit for observation.

A circular head, with coloured glasses, (Fig. 7.) sometimes accompanies the Sextant, and is to be screwed on the eye end of the tube, or on that of either telescope. The glasses are contained in a circular plate, which has four holes; three of these are fitted with coloured glasses, the fourth is open. By pressing the finger against the projecting edge of this circular plate, and turning it round, the open hole, or any of the coloured glasses may be brought between the eye glass of the telescope and the eye.

To these appendages are added a small screw-driver, to adjust the screws; a magnifying glass, (Fig. 6.) to read off the observation with greater accuracy; and a microscope (Fig. 5.) for the same purpose, made to fit into a tube fixed at the lower end of the Index.

ADJUSTMENTS OF THE SEXTANT.

To adjust a Sextant is to set the Index and Horizon glasses perpendicular to the plane of the instrument, and their planes parallel to each other when the Index division is at 0 on the Arch; also to set the axis of the telescope parallel to the plane of the instrument; each of these particulars must be examined before an observation is taken, and the adjustments, if requisite, made according to the following directions.

I. *To set the Index-Glass perpendicular to the Plane of the Sextant*

Move the Index forward to about 60 degrees; then, holding the instrument horizontally with the limb from the observer, look obliquely down the Index-glass, and see if the reflected and the true Arches appear to be in the same plane: if they are, the glass is adjusted; otherwise it is to be rectified by the screws behind the glass, as directed for the Quadrant, page 176.

II. *To set the Horizon-glass perpendicular to the Plane of the Sextant.*

Screw on the plane tube, or the common telescope, and holding the Sextant horizontally, observe if the reflected and true horizons appear in the same strait line; if they do, the glass is adjusted; otherwise turn the screw at the back of the instrument till they perfectly coincide: this adjustment may also be made by directing the telescope to the Sun, Moon, or a Star, in which case hold the instrument perpendicularly to the horizon, and move the Index till the direct object and its reflected image appear nearly in contact, by placing the 0 on the Nonius about 30 minutes on either side of 0 on the Arch; then, if the reflected image be to the right or left of the direct object, turn the screw under the Horizon-glass till they are perpendicular to each other, and consequently parallel to the plane of the instrument. If the adjustment be made by a Star, move the Index backwards and forwards slowly, and observe if the reflected image, in passing the Star, coincide with it; if it does not, the glass is to be adjusted by the screw as before.

Horizon-glasses are fitted up in various ways, to admit to this adjustment; in some Sextants, a screw connected with the brass frame of the horizon-glass, which moves on two points, is placed behind, over which a brass cap is screwed, to secure it from accidents; in others a small screw is placed at the top of the frame, and is moved by a steel lever pin; by means of these screws the horizon-glass is set perpendicular to the plane of the instrument.

When this or the following adjustment is made by observing the Sun, the inverting telescope is always to be used, and one or more of the Shades both before and behind the Horizon-glass are to be turned up, in order to screen the eye from the bright solar rays proceeding from the direct and reflected Suns, which are to be made by means of the Shades, to appear as nearly as possible of the same degree of brightness.

III. *To set the Horizon-Glass parallel to the Index-Glass when the Index Division is at* 0 *on the Arch.*

Make the Index division of the Nonius coincide exactly with 0 on the Arch; and, in order to make the coincidence as perfect as possible, examine them through the magnifying glass; screw on the telescope, and turn the screw L at the back of the instrument till the line which separates the transparent and silvered parts of the horizon-glass bisects the field of the telescope: having done this, hold the Sextant perpendicularly, and direct the sight through the telescope to the horizon; then, if the reflected and true horizons do not coincide, turn the tangent screw at the back of the horizon-glass till they are made to appear in the same strait line. Then will the planes of the Horizon and Index Glasses be parallel.

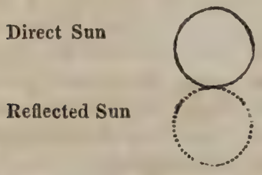
This adjusment in some instruments is made by means of two screws placed near the horizon-glass, which act against each other in turning the frame round its axis; these screws are moved by a steel lever pin, put into one of the holes made through the head of the screw, and in making the adjustment by these screws care must be taken, that when one is slackened the other must be tightened, in order that they may sufficiently press against each other, and prevent the horizon-glass from altering its position, when the direct and reflected horizons are made to coincide. But although the adjustment made by these screws is not so liable to alter as when made by a tangent screw, it is recommended not to depend on this adjustment, but rather to find the *Index Error;* and indeed this becomes absolutely necessary when the horizon-glass is so constructed as not to admit of the adjustment, which is the case with most modern instruments.

To find the Index Error.

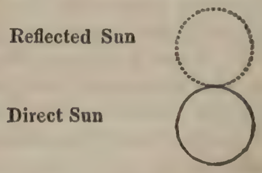
The *Index Error* is the number of minutes and seconds pointed out by the Nonius, when the direct object and its reflected image coincide with each other, and may be found as directed in the adjustment of the fore horizon-glass of the quadrant, in page 177, but with greater accuracy by the following method :

Having screwed on the inverting telescope, adjusted the eye tube to distinct vision, and turned up the proper shades, place the 0 on the Nonius about 40 minutes to the *right* of 0 on the Arch, and tighten the screw c under the Index of the Sextant ; then, holding the instrument perpendicularly, bring the direct and reflected Suns in exact contact by the tangent screw, and read off the minutes and seconds pointed out by the Nonius on the *arch of excess*, which note down and call it *off ;* next place the 0 of the Nonius about 40 minutes to the *left* of 0 on the Arch, and make the contact of the two Suns correct as above ; read the minutes and seconds shewn by the Nonius, which call *on*, and set it under the first Arch ; then half the difference of these two Arches will be the Index error, which is *additive* to all angles taken with the Sextant, when the Arch to the right of 0 is greater than the Arch to the left of 0, and *subtractive* when the contrary. The direct and reflected Suns will appear through the inverted Telescope thus

When the Index division is to the right of 0 on the Arch.



When the Index Division is to the left of 0 on the Arch.



Suppose the following observations were taken to determine the Index Error :

EXAMPLE I.

		′	″
Off	+	31	45
On	—	33	0
	2)	1	15
	—	0	37

Index Error 0′ 37″ subtractive because the Arch to the left is greater than the Arch to the right of 0.

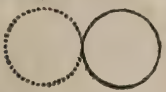
EXAMPLE II.

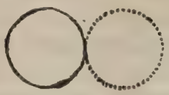
		′	″
Off	+	32	10
On	—	31	20
	2)	0	50
	+	0	25

Index Error 25″ additive because the Arch to the right is greater than the Arch to the left of 0.

To prove that the contacts were made correctly, add the Arches together and divide their sum by 4; the quotient should then be equal to the Sun's semidiameter as given in page III. of the Nautical Almanac: thus suppose the observations in Example I. were made on February 12th, 1827, here the sum of the Arches is 64′ 45″, the fourth part of which is 16′ 11″, agreeing nearly with the Sun's semidiameter (16′ 12″) as given on that day in the Nautical Almanac, it may therefore be presumed that the contacts were correctly made.

But if the altitude of the Sun should be less than about 30° at the time of taking the above observations, the Sun's horizontal, instead of the perpendicular, diameter should be measured; for as refraction affects the lower limb more than the upper, it occasions the perpendicular diameter to be less than the horizontal, which is that given in the Nautical Almanac; in this case, the Sextant is to be held horizontally, with the face upwards, and the reflected Sun brought into contact alternately with the right and left limbs of the direct Sun, as before explained. The contacts will then appear thus





IV. *To set the Axis of the Telescope parallel to the Plane of the Sextant.*

In measuring angular distances, the line of sight, or axis of the telescope, should be parallel to the plane of the instrument, as a deviation in that respect will occasion a considerable error in the observation, and this is most sensible in large angles; to avoid which, a telescope is made use of in whose field there are placed two wires, parallel to each other, and equidistant from the center, to which are generally added two others at right angles to these, and parallel to each other: by means of these wires the adjustment may be made thus: screw on the telescope, and turn the tube containing the eyeglass till the wires are parallel to the plane of the instrument; then take two objects, as the Sun and Moon, or the Moon and a Star, whose angular distance must not be less than 90 degrees, because the error is more easily discovered when the distance is great; bring them exactly into contact at the wire which is nearest the plane of the Sextant, and fix the Index: then, by altering a little the position of the instrument, make the objects appear on the other wire: if the contact still remains perfect, the axis of the telescope is in its right situation; but if the limbs of the two objects appear to separate at the wire that is furthest from the plane of the instrument, it shews that the object end of the telescope inclines towards the plane of the instrument, which must be rectified by tightening the screw nearest the Sextant, which is attached to the ring that holds the telescope, having previously slackened the screw farthest from it; if the images overlap each other at the wire farthest from the Sextant, the object end of the telescope is inclined from the plane of the Sextant, and the highest screw must be turned towards the right, and the lowest towards the left: by repeating this observation a few times, the contact will be precisely the same at both wires, and consequently the axis of the telescope will be parallel to the plane of the instrument.

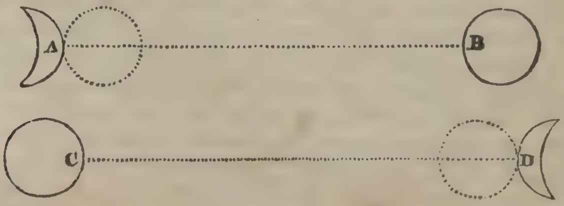
USE OF THE SEXTANT.

To observe the Angular Distance between the Moon and the Sun.

Turn up one or more of the shades before the horizon glass, according to the brightness of the Sun, and set the Index division to 0 on the arch; then holding the plane of the Sextant so as to pass through the two objects, with its face upwards, when the Sun is to the right hand of the Moon; or downwards, when the Sun is to the left; (see figures below) direct the sight through the ring K, and the horizon-glass, to the Moon, without using the telescope, and move the Index forward until the Sun's image comes nearly in contact with the Moon's nearest limb; then fix the Index by the screw C under the Sextant. Now screw on the *inverting* telescope, adjusted to distinct vision, placing the wires parallel to the plane of the instrument, and raising the telescope, by the screw L, to the transparent part of the horizon-glass; then directing the sight through the telescope to the Moon, holding the Sextant as before directed, make the contact perfect by means of the tangent screw B; at the same time moving the Sextant slowly round the axis of the telescope, by which means the Sun will appear to pass by the Moon, and the contact be more accurately made; observing always, that the point of contact of the limbs should be as near the center of the field of the telescope as possible.

The arch pointed out by the Nonius being now read off as before directed, will shew the observed distance of the nearest limbs of the Sun and Moon.

In the following figures A B represents the observed distance of the nearest limbs when the Sun is to the right of the Moon, and C D the distance when the Sun is to the left of the Moon.



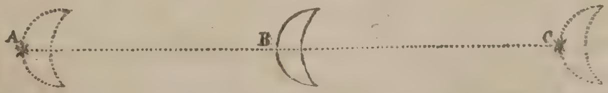
It will perhaps be more easy for those who are not accustomed to take observations, to find the distance nearly, and setting the Index forward to it, to look directly towards the Moon, holding the instrument as before; the Sun will then appear nearly in contact with it, and is to be made perfect by the method above-mentioned. In the Nautical Almanac the distances of the Sun and Moon are set down for the beginning of every third hour of time at Greenwich, on such days as the Moon is not less than 35 degrees, nor more than 125 degrees from the Sun, and may be found for any intermediate time by proportion; from these distances you may compute roughly their distance at the time of observation thus; turn the ship's longitude into time by Table XIX. and add it to, or subtract it from, the time of observation, according as the longitude is west or east, the sum or difference will give the time at Greenwich; then find by the Ephemeris the distance nearly at that time, from which subtract 30 minutes, the sum of the semidiameters and the remainder will give the distance of their nearest limbs at the time of observation.

It will save some trouble, and serve the purpose of finding the reflected image of the Sun or Moon in the horizon glass, if you only set the Index to the central distance as set down in the Almanac for the nearest third hour, without correcting it to the intermediate time by a rough computation.

To observe the Distance between the Moon and a Star.

Turn up one of the lightest screens before the horizon-glass, and, without the telescope, direct the sight through the ring K, and the horizon-glass, to the Star; holding the Sextant in such a direction that if its plane be seen edgewise it may appear to pass through the Moon and the Star, with its face upwards or downwards, according as the Star is to the left or right of the Moon; then move the Index forward until the reflected image of the Moon is seen near to the Star. Now screw on the inverting telescope, and adjust it as before directed; bring the *enlightened* edge of the Moon into contact with the Star by means of the tangent screw, at the same time moving the Arch of the Sextant slowly up and down, by which motion the enlightened limb of the Moon will appear to pass the Star, and the contact be more accurately made, which should always be as nearly as possible to the center of the field of the telescope. The Arch being then read off will give the observed distance between the Star and the Moon's enlightened limb.

In the following figure A B represents the distance of the Star at A from the Moon's nearest limb at B, and B C the distance of the Moon's furthest limb from the Star at C.



If the distance between the Moon and one of the Stars set down in the Almanac, for finding the Longitude is to be observed, their distance may be roughly calculated, as before directed, to which set the Index: then look through the telescope and direct the sight to the Star, which is generally a bright one, and lies in a line nearly perpendicular to the horns of the Moon, either to the eastward or westward, as denoted in the Almanac; and holding the Sextant in the plane of the two objects, give it a slow motion round the axis of the telescope, and if the Moon's image comes into the field of the telescope it is a proor you have taken the right Star, as no other in that direction will correspond to it in distance.

DESCRIPTION AND USE
OF THE
ARTIFICIAL HORIZON.

WHEN Altitudes are to be taken on Shore with a Sextant, where the observer has not the advantage of the Sea Horizon, he is obliged to have recourse to an Artificial Horizon, which is a horizontal plane with a smooth or polished surface, on which the rays of the Sun, or other object, falling, are reflected back to an eye placed in a proper position to receive them: the angle between the real and reflected objects being then measured with a Sextant, will be double the altitude above the horizontal plane.

Such a horizontal plane may be obtained by pouring a quantity of oil, tar, treacle, or other fluid and viscous substance, into a shallow vessel; and, to prevent the wind giving a tremulous motion to its surface, a piece of thin gauze, muslin, or plate glass, whose surfaces are perfectly plane and parallel, may be placed over it when used for observation.

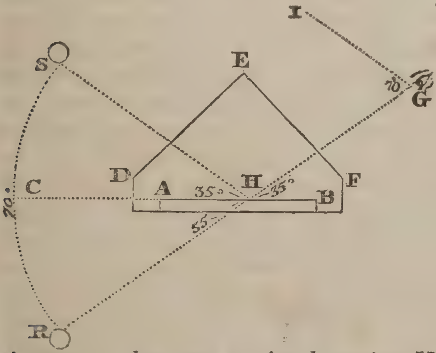
An Artificial Horizon sometimes consists of a plane speculum, fixed in a brass frame, standing upon three adjusting screws, by which its surface may be made horizontal, with the assistance of a spirit level, placed on its surface, in various positions; observing that the screws be turned until the air bubble always rests in the middle of the tube. The under surface of the plate of glass is sometimes unpolished and blackened, so that the image of the Sun can only be reflected from the upper surface, which should be carefully polished and a perfect plane: by this means the errors that might arise from a defect of parallelism in the two surfaces, are avoided.

But the best and most approved kind of artificial horizons are those produced by quicksilver, which being poured into a small wooden trough, will always, agreeably to the nature of fluids, preserve an exact horizontal plane at its surface; over this is placed a roof, to protect the quicksilver from the action of the wind; in which are fixed two plates of glass, the two sides of each being ground perfectly plane and parallel. These are usually packed in a mahogany box, with a vessel containing a quantity of quicksilver, ready for use when wanted, When one of these instruments is used, the observer is to place himself at a convenient distance, for instance, two or three feet, in such direction, that he may see the object reflected from the artificial horizon as well as the real object; then, having screwed on the telescope of the sextant, and turned down the dark glasses before and behind the horizon glass, the upper or lower limb of the sun's image reflected from the Index glass, is to be brought into contact with the opposite limb of the image reflected from the artificial horizon, observing that when the inverted telescope is used, the upper limb will appear as the lower, and *vice versa**; the angle on the instrument being then read off, and the index error applied to it, will give double the altitude of the limb above the horizontal plane; to the half of which, if the semidiameter, refraction, and parallax, be applied, the result will be the true altitude of the center.

EXAMPLE. Suppose August 12, 1830, the observed angle between the lower limb of the Sun reflected from the Index Glass of the Sextant, and the upper limb reflected from the artificial horizon, to be 99° 45′ 30″, the Index Error of the Sextant being 2′ 20″ to add: required the true altitude of the Sun's center.

	°	′	″
Observed Angle	99	45	30
Index Error	+	2	20
	2) 99	47	50
Obs. alt. of Sun's lower limb	49	53	55
Sun's semidiameter	+	15	49
Refraction	—		48
Parallax	+		6
True alt. of Sun's center	50	9	2

The following diagram will illustrate the method of observing altitudes with an artificial horizon:



Let A B represent the surface of the quicksilver contained in a wooden trough, whose plane is continued to C; D E F, the roof, in which are fixed two plates of glass, D E and E F, whose surfaces are plane and parallel to each other; and ☉ the Sun at S. whose altitude is required. Now the ray S H, proceeding from the Sun's lower limb to the surface of the quicksilver, will be reflected thence to the eye, in the direction H G, and the upper limb of the Sun's image, reflected from the quicksilver, will appear in the line G H, continued to R; and it is a well known principle in catoptrics, that the angle of incidence S H A or S H C, is equal to the angle of reflection G H B; and as the angle A H R or C H R, is vertical or opposite to the angle G H B, it is therefore equal to it, and to the angle S H C; consequently the angle S H R is double the angle S H C, the altitude of the sun's lower limb above the horizontal plane; so that if we suppose the angle S H R measured by a sextant to be 70°, the altitude of the sun's lower limb will be 35°.

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* It will perhaps be more easy to the observer if he first bring the images of the Sun nearly into contact by the naked eye, and afterwards screw on the telescope and make the contact perfect by the tangent screw.

In theory the eye of the observer should be placed at the angular point H, but as a ray I G, proceeding from so distant an object as the sun to the eye at G, may be considered as parallel to the ray S H, the measured angle I G H will be equal to the angle S H R.

OF FINDING THE

LONGITUDE BY OBSERVATION.

A VARIETY of methods have been proposed for determining the longitude of a place, but almost all of them depend upon one general principle, viz. the comparison of the relative times under two different meridians; so that if the time under a given meridian be known, and also the time under any other meridian, the difference of these times turned into degrees and minutes in the proportion of 15 degrees to 1 hour, will be the difference of longitude between the two meridians. For as the Sun apparently moves round the Earth, from east to west, in 24 hours, or over an arch of 15 degrees of the equator in 1 hour of time, all places lying to the eastward of any meridian will have noon sooner, or if to the westward later, by as much time as the Sun takes to pass from the meridian of one place to the meridian of the other; hence, if the time at the meridian of Greenwich (from whence the longitude is reckoned,) and of any other place, at the same moment of absolute time, be given, its longitude from Greenwich may be inferred by reducing the difference of the times into degrees and minutes, in the proportion of 15 degrees of longitude to 1 hour of time: moreover, if the time at the place be greater than that at Greenwich, its longitude will be east, but if less it will be west. Thus, suppose it is ascertained that the time at Greenwich is 2 hours past noon when it is just noon at the ship; it will thence appear that the longitude of the ship is 30° west of the meridian of Greenwich, because the Sun passes over 30° of the equator in 2 hours of time; and having left the meridian of Greenwich 2 hours since, the ship must consequently be to the westward of that meridian. If we suppose the time at the ship to be 4 hours past noon, her longitude would be 30° east of Greenwich, for the Sun in this case would have passed the meridian of the ship 2 hours before he passed that of Greenwich.

Now the time at any given meridian may be easily computed by an altitude of the Sun or a Star, taken when distant from the meridian, or from observations of the Sun when at equal altitudes; and the time at Greenwich may be ascertained by means of a time-keeper, or by various astronomical observations. With respect to the first of these, it is obvious, that if a clock or watch could be so constructed as to go uniformly in all seasons, and at all places, such a machine being once set to the time at Greenwich, would always shew the real time at Greenwich, in whatever part of the earth it might be; and therefore, when the time under any other meridian was found and compared with that shewn by the time-keeper, the longitude of the place from Greenwich would be readily obtained. To effect this purpose several ingenious artists have exerted their abilities, and have brought time-keepers to an astonishing degree of perfection, whereby they have become a valuable acquisition to the Navigator, in determining the difference of longitude made in short periods; however, considering the delicacy of their construction, and the various accidents to which they are liable, an implicit confidence ought not to be placed on them, particularly in long voyages; but recourse should be had to astronomical observations whenever opportunities present themselves.

The various astronomical methods of determining the longitude depend likewise upon the abovementioned general principle; for by observing the time at the meridian of a given place when any celestial appearance happens, and comparing the same with the time at Greenwich, as shewn by the Nautical Almanac*, their difference, reduced to degrees and minutes, give the longitude as before. Suppose, for instance, that an eclipse of the Moon should be observed at a certain place to begin at midnight, and that by the Almanac, the time at Greenwich when the eclipse commenced was 3 hours past midnight: now as the commencement of the eclipse must be seen at the same moment of absolute time in all parts where it is visible, the difference between the time at the place of the observer and that of Greenwich, which is 3 hours, and answers to 45 degrees, must be the longitude of the place; and it is evidently west because the time at the place is less than the time at Greenwich. Upon the same principle the eclipses of Jupiter's satellites will give the longitude. But eclipses of the Moon happen too seldom to be of use at sea, and the satellites of Jupiter are visible only through a telescope of considerable magnifying powers, which cannot be managed on board a ship.

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* The Nautical Almanac is published annually by order of the Board of Longitude generally four years forward, and contains XII pages to each month: in these are entered the Sun's longitude, right ascension, declination; the Planets' longitudes, latitudes, times of passing the meridian; the times of solar and lunar eclipses, together with those of Jupiter's satellites: the distances of the Moon from the Sun and certain fixed Stars, at the beginning of every third hour; and in general, the times when any remarkable appearance takes place; being all computed for Greenwich time. This excellent and most useful Work was originally proposed by, and calculated and printed under the immediate inspection of, the late Dr. Maskelyne, Astronomer Royal, and is now continued by Mr. Pond who has succeeded Dr. M. in the above important situation.

The most practical method of finding the longitude at sea, by celestial observations, is that of measuring the angular distance between the Moon and Sun, or the Moon and certain stars near the ecliptic, usually called a *lunar observation*, both on account of the quick motion of the Moon in her orbit, and the frequent opportunities that offer for taking such observations; for in favourable weather distances may be taken at all times when the objects are more than 4 or 5 degrees above the Horizon, except about the time of new Moon; and, as the Moon's daily motion is about 13 degrees, or at the rate of 1 minute of a degree in two minutes of time, if her true angular distance from the Sun or a Star can be ascertained within 30″ of a degree, the corresponding time at Greenwich will be known within one minute of time, and hence the longitude within 15 minutes of a degree.

This method of determining the longitude was proposed many years ago by Mr. John Werner and others, but for want of proper instruments to observe the distances, and a good lunar theory to ascertain the Moon's place, it was laid aside. These difficulties are, however, now happily obviated by the invention and improvements of Hadley's Sextant, and the accuracy of the new Lunar Tables; so that a good observer, with proper instruments, may depend upon the longitude found by this method, within half a degree.

To facilitate this important problem, the true angular distances of the Moon from the Sun or a fixed Star[*], are set down in pages VIII, IX, X, and XI, of each month, in the Nautical Almanac, for the beginning of every third hour of Greenwich time; and the time answering to any intermediate distance, may be found by proportional parts; hence the distance between these objects being taken with a Sextant or Circle, and the corresponding time at Greenwich found by the Almanac, and compared with the time at the ship, their difference will be the longitude of the place of observation.

But before the observed distance is compared with those in the Almanac it must be corrected, in order to find the true distance; for, by the effects of parallax and refraction, the Moon is always seen lower than its true place, and the Sun or Star higher; hence the true distance is almost always greater or less than the observed.

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[*] The Stars used in the Nautical Almanac for the above purposes are, α *Arietis*, *Aldebaran*, *Pollux*, *Regulus*, *Spica Virginis*, *Antares*, α *Aquilæ*, *Fomalhaut*, and α *Pegasi*. As a knowledge of these Stars is of great importance to the observer, the Author has published a set of Celestial Maps, with directions for using them;in which the above Stars are particularly pointed out, and may be more readily known by comparing the maps with the heavens, than they possibly can by any verbal description

In taking a *lunar observation*, two assistants should be employed to observe the altitudes of the objects while the principal observer is taking their distance; also one with a watch to mark the times when the observations were made. If the Sun or Star be at a proper distance from the meridian, the time may be inferred from its altitude, but if it be too near the meridian, a watch will be absolutely necessary, whose error must be found by an altitude taken before or after the lunar observation, according as it it is most convenient.

The Quadrants and Sextant being properly adjusted, and their Index errors found, place the assistants in the most convenient situation, and let the one holding the watch be provided with a paper and pencil to note down the observations when taken: all things being ready, proceed to take the distance between the objects, the assistants at the same time observing the altitudes of each; when this is done, give notice to the assistant with the watch, who is to mark the exact time, and set it down, together with the observations read off from the instruments; in this manner proceed four or five times, each set of observations being noted down in proper order; then take the mean of the times, and of each observation, by adding them together, and dividing their sum by the number of sets observed, the quotient will give the mean of each set, which is much more to be depended upon than if one set only were taken.

The following example will shew the form in which a set of lunar observations are to be written down.

June 5th, 1805. Height of the eye 20 feet.

	Times by watch.			Alt. of * Antares			Alt. of ☽'s l. l.			Dist. ☽'s far. l.			
	h	m	s	°	′	″	°	′	″	°	′	″	
	9	21	0	26	51	0	41	45	30	62	26	53	
		22	20	27	0	0	41	33	0		26	12	
		23	5	27	4	0	41	25	30		25	51	
		24	15	27	12	0	41	14	30		25	14	
		26	0	27	24	0	40	58	0		24	25	
5)		116	40	135	31	0	206	56	30		128	35	
Means -	9	23	20	27	6	12	41	23	18	62	25	43	
Err of watch. +			10	—	1	0	—	1	15	—		10	Ind.Errs
	9	23	30	27	5	12	41	22	3	62	25	33	

It may sometimes happen, that for want of proper assistants the altitudes of the two objects cannot be taken at the same time with their distance; in which case the altitudes may be inferred from the apparent time and the latitude of the ship, according to rules laid down for that purpose; but it must be observed, that unless these be well determined, the operation will bring out a considerable error; it will therefore be found much more accurate to adopt the following method, by which one person can take a set of observations without assistants: having a good Quadrant to take the altitudes, and a Sextant to observe the distances.

Let the observations be taken in the following order, noting the times by a watch: 1, the altitude of the Sun or Star; 2, the altitude of the Moon; 3, any number of distances; 4, the altitude of the Moon; 5, the altitude of the Sun or Star. Now add together the distances, and the times when they are taken, each of which being divided by the number observed, will give the mean time and distance: then to reduce the altitudes to the mean time, say, as the difference of times between the observations, is to the difference of their altitudes, so is the difference between the time that the first altitude was taken and the mean time, to a fourth number; which, added to or subtracted from the first altitude, according as it is increasing or decreasing, will give the altitude reduced to the mean time.*

EXAMPLE.

Suppose the following observations were taken at the undermentioned times; required the altitudes of the Sun and Moon reduced to the mean time and distance?

	Times per watch.			
	$3^h\ 25^m\ 41^s$	Alt. of Sun's lower limb -	54° 5′ 0″	
	28 44	Alt. of Moon's upper limb -	20 3 0	
Mean time $3^h\ 33^m\ 47^s$	32 50	Dist. nearest limbs - -	73 13 30	Mean dist. 73° 14′ 3″
	33 30	Dist. nearest limbs - -	73 14 10	
	35 0	Dist. nearest limbs - -	73 14 30	
	38 20	Alt. of Moon's upper limb -	20 45 0	
	42 4	Alt. of Sun's lower limb - -	53 14 0	

	Times.	Altitudes.	Times.	
1st. alt.	$3^h\ 25^m\ 41^s$	54° 5′	$3^h\ 25^m\ 41^s$	1st. altitude.
2d. alt.	3 42 4	53 14	3 33 47	mean time.
Diff. .	16 23 ——	51 ——	8 6 —	0° 25′ 13″
		First altitude of Sun's lower limb -		54 5 0
		Reduced altitude of Sun's lower limb		53 39 47

	Times.	Altitudes.	Times.	
1st. alt.	$3^h\ 28^m\ 44^s$	20° 3′	$3^h\ 28^m\ 44^s$	1st altitude.
2d. alt.	3 38 20	20 45	3 33 47	mean time.
Diff. -	9 36 ——	42 ——	5 3 —	0° 22 6″
		First altitude of Moon's upper limb		20 3
		Reduced altitude of Moon's upper limb		20 25 6

Hence we obtain the following set of observations.

Time per watch	Dist. near l. of ⊙ & ☾.	Alt. of ⊙'s low. l.	Alt of ☽'s up. l.
$3^h\ 33^m\ 47^s$	73° 14′ 3″	53° 39′ 47″	20° 25′ 6″

OF FINDING THE TIME AT A GIVEN PLACE, AND THENCE THE ERROR OF A WATCH.

Before we proceed to shew the methods of finding the time under a given meridian, it will be necessary to premise that there are three different modes of reckoning time, with respect to the commencement of the day; these are denominated civil, astronomical, and nautical.

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* The change of altitude may be readily found by Proportional Logarithms—see explanation to Table XXXIV.

The CIVIL DAY, which is that used by the generality of mankind, begins at midnight and ends at the midnight following; it is divided into two equal parts of twelve hours each; the first are marked A. M., signifying *Ante Meridiem*, or before noon, and the latter 12 are marked P. M., signifying *Post Meridiem*, or after noon.

The ASTRONOMICAL DAY begins 12 hours after the civil day; that is, at noon, or when the Sun's center is on the meridian, and concludes at the following noon. It is generally reckoned through the 24 hours from noon to noon, and what are by the civil or common way of reckoning called morning hours, are by Astronomers reckoned in succession from 12, or midnight, to 24 hours. Thus 9 o'clock in the morning of July 3d, is by Astronomers called July 2d at 21 hours.

The NAUTICAL, or SEA DAY, commences at noon, or 12 hours before the civil day, and ends at noon of the civil day; it is divided into two parts of 12 hours each, the former being marked P. M. and the latter A. M. This mode of reckoning arises from the custom of seamen dating their day's work for the preceding 24 hours the same as the civil day; so that occurrences which happen, for instance, on Monday 21st after noon, are entered in the Log marked Tuesday 22d.

Hence it appears that the noon of the civil day, the beginning of the astronomical day, and the end of the nautical day, take place at the same time.

Time, as inferred from observations of the Sun, is denominated apparent and mean solar time.

APPARENT TIME is that which is immediately derived from the Sun, either by observing its transit over the meridian, which happens at the instant of *apparent noon*, or by observing its altitude at a distance from the meridian.

EQUAL or MEAN TIME, is that which is shewn by good clocks or watches properly regulated, which are supposed always to have a uniform and regular motion.

The reason of these two different methods of dividing time is the unequal motion of the Earth in his orbit, combined with the inclination of its axis to the plane of the ecliptic; whereby the intervals of the Sun's returning to the meridian are unequal in different times of the year; sometimes coming too slow and at other times too soon to the meridian for an uniform motion, such as that shewn by well-regulated clocks or watches. This retardation or acceleration of the Sun's coming to the meridian, which sometimes amounts to more than 16 minutes, is called the EQUATION OF TIME; it is set down in page II. of each month in the Nautical Almanac, and is to be applied to apparent time, as denoted in the column from whence it is taken, in order to reduce it to mean time.

To find the apparent Time at the Ship, and thence the Error of the Watch, by an altitude of the Sun.

RULE.—1. To the observed altitude of the Sun's lower limb add the difference between the semidiameter (from page III. of the Nautical Almanac,) and the dip (V.;) from their sum subtract the refraction (IV.) and the remainder will be the Sun's true altitude.

2. Take out the Sun's declination for the nearest noon, from page II. of the month in the Nautical Almanac, and correct it for longitude and time (XXI.) Then proceed according to one of the following Methods.

METHOD I.

1. Subtract the Sun's declination from 90°, when the latitude and declination are of the same name; or add it to 90° when they are of contrary names; and the sum or remainder will be the Sun's polar distance.

2. Add together the Sun's altitude, the polar distance, and the latitude of the place of observation; take the difference between half their sum and the Sun's altitude, and note the remainder:

3. Then add together,

The co. secant of the polar distance (XXV.)
The secant of the latitude;
The co. sine of the half sum;
The sine of the remainder;
And the constant logarithm 5.30103.

4. The sum of these five logarithms, rejecting tens in the index, will be the log. rising (XXIX.) answering to the apparent time from the nearest noon; consequently, if the observation be made in the morning, the time thus found must be taken from 24 hours to obtain the apparent time from the preceding noon. Hence the error of the watch may be found.

METHOD II.

1. If the Sun's declination and co. latitude of the place be one north and the other south, take their difference; but if they be both north or both south, take their sum for the meridian altitude. If that sum exceed 90° take it from 180°.

2. From the natural sine of the Sun's meridian altitude (XXVI.) take the natural sine of the Sun's true altitude; then add together

The log. co. secant of the co. latitude (XXV.), } rejecting their indices.
The log. secant of the declination, }
And the log. of the difference of the natural sines (XXIV.)

3. The sum of these three logarithms being found in the Table of rising (XXIX.,) the corresponding time will be the apparent time from the nearest noon, as before.

METHOD III.

1. When the Sun's declination and the latitude of the place are of the same name, take their difference, but when they are of contrary names take their sum, under which set the Sun's zenith distance*; take the sum and difference of these, also the half sum and half difference; then add together,

2. The log. secant of the latitude (XXV.)
The log. secant of the declination;
The log. sine of the half sum;
The log. sine of the half difference;
And the constant logarithm 5.301030.

The sum of these five logarithms (rejecting tens in the index) will be the log. rising (XXIX.) answering to the apparent time from noon, as before.

This method of finding the apparent time will be found very convenient when it is required to work to the nearest second; since the proportional parts to seconds, being all additive, may be added at once with the logarithms, to find the log. rising.

NOTE. The observations should be taken when the Sun is at least three points from the meridian, and the nearer it is to the east or west points of the horizon the better, because then the change of altitude is quickest, and an error of a few miles in latitude will not materially affect the time.†

It will be proper to observe several altitudes, noting the times by the watch when each is observed, and to use the means of the sets, which are found by adding the sets together, and dividing their sum by the number that are taken.

EXAMPLE I.

August 16, 1830, the following observations were made of the Sun's lower limb, in latitude 36° 31′ N. and longitude by account 152° E. the height of the eye being 20 feet: required the apparent time, and from thence the error of the watch.

Times.	Altitudes.				
n. m. s	° ′		° ′ ″		° ′ ″
4 40 0	24 20	Obs. alt. ☉'s lower l.	23 50 24	☉'s dec. Aug. 16,	13 50 45 N
41 10	24 4	Sun's semid. 15′49″	+ 11 32	Corr. for long.	+ 8 9
42 5	23 50⅓	Dip of hor. 4 17			
43 0	23 36				13 58 54
44 17	23 21½	Sun's app. altitude	24 1 56	Corr. for time	− 3 46
		Refraction	− 2 8		
5) 210 32	119 12			☉'s red. declin.	13 55 8
		Sun's true altitude	23 59 48		90
4 42 6	23 50 24 Means.				
				Polar distance	76 4 52

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* The zenith distance is found by subtracting the altitude from 90°.

† The time from noon when the Sun bears east or west is found by Table XL.

METHOD I.

	°	′			
True altitude .	24	0			
Polar distance .	76	5		Co. secant	0.01294
Latitude .	36	31		Secant	0.09492
Sum .	136	36			
Half Sum .	68	18		Co. sine	9.56790
Remainder .	44	18		Sine	9.84411
				Const. Log.	5.30103
	h.	m.	s.		
Apparent time	4	41	0	Log. rising	4.82090
Time per watch	4	42	6		
Watch too fast		1	6		

METHOD II.

	°	′						
Co. latitude .		53	29	N.			Co. secant	0.09492
Declination .		13	55	N.			Secant	0.01294
Meridian altitude .		67	24		Nat. sine	92321		
True altitude .		24	0		Nat. sine	40674		
					Difference	51647	Log.	4.71305
	h.	m.	s.					
Apparent time .	4	41	0				Log. rising	4.82091
Time per watch .	4	42	6					
Watch too fast .		1	6					

METHOD III.

	°	′	″							
Latitude .	36	31	0	N.					Secant	0.094915
Declination .	13	55	8	N.					Secant	0.012939
										4*
Difference .	22	35	52							
Zenith distance .	66	0	12							
						°	′	″		4
Sum .	88	36	4		Half	44	18	2	Sine	9.844114
Difference .	43	24	20		Half	21	42	10	Sine	9.567904
										53
									Const. Log.	5.301030
	h.	m.	s.							
Apparent time	4	41	1						Log. rising	4.82096.
Time per watch .	4	42	6							
Watch too fast .		1	5							

EXAMPLE II.

March 14, 1830, the following observations of the Sun's lower limb were made in latitude 17° 28′ 30″ N. and longitude 99° 30′ W. the height of the eye being 22 feet, and the error of the Sextant

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* For the method of finding the proportional parts to seconds, see explanation to Table XXV. page xxii.

2′ 50″ to be subtracted: required the apparent time and error of the watch.

Times.	Altitudes.				
h. m. s	° ′ ″		° ′ ″		° ′ ″
18 42 52	10 28 45	Obs. alt. ⊙'s lower l.	10 33 20	⊙'s dec. Mar. 15,	2 12 49 S.
44 50	35 30	Sun's semid. 16′ 6″	+ 11 36	Corr. for long.	− 6 29
46 44	44 15	Dip of hor. 4 30			
					2 6 20
		Sun's app. altitude	10 44 56	Corr. for time	+ 5 5
3) 134 26	108 30	Refraction .	− 4 54		
				⊙'s red. declin.	2 11 25
18 44 49	10 36 10	Sun's true altitude	10 40 2		90
24	− 2 50	Index Error.			
				Polar distance	92 11 25
5 15 11	10 33 20				
Time from noon, March 15.					

METHOD I.

	° / h.	′ / m.	s.		
True altitude .	10	40			
Polar distance	92	11½	.	Co. secant	0.00032
Latitude .	17	28½	.	Secant	0.02052
Sum .	120	20			
Half Sum .	60	10	.	Co. sine	9.69678
Remainder .	49	30	.	Sine	9.88105
				Const. Log.	5.30103
Time from noon	5	12	24	Log. rising	4.89970
	24				
Apparent time	18	47	36		
Time per watch	18	44	49		
Watch too slow		2	47		

METHOD II.

	° / h.	′ / m.	s.				
Co. latitude .	72	31½ N.		.		Co. secant	0.02052
Declination .	2	11½ S.		.		Secant	0.00032
Meridian altitude .	70	20		Nat. sine	94167		
True altitude .	10	40		Nat. sine	18510		
				Difference	75657	. Log. .	4.87885
Time from noon	5	12	24	.	.	Log. rising	4.89969

METHOD III.

	° / h.	′ / m.	″ / s.				
							20
Latitude .	17	28	30 N.	.	.	Secant	0.020501
Declination .	2	11	25 S.	.	.	Secant	0.000315
							2
Sum .	19	39	55				
Zenith distance .	79	19	58				
					° ′ ″		101
Sum .	98	59	53	Half	49 29 56	. Sine	9.880938
Difference .	59	40	3	Half	29 50 1	. Sine	9.696775
							4
						Const. Log.	5.301030
Time from noon .	5	12	24	.		Log. rising	4.89969.

Having found the time from noon, proceed to find the error of the watch as in the first method.

To find the apparent Time, and thence the Error of the Watch, by an Altitude of a Star.

RULE.—1. From the observed altitude of the Star, subtract the dip and refraction (V. IV.), and the remainder will be the Star's true altitude.

2. Reduce the Star's right ascension and declination (XIV.), and the Sun's right ascension (taken from page II. of the Nautical Almanac), to the time of observation (XXII.)

3. Proceed as with the Sun, by either of the methods in the last problem, to find the hour angle, or Star's distance from the meridian (which with the Sun is the time from noon;) this being added to the Star's right ascension; if the Star be to the westward of the meridian,* or subtracted from it if the Star be to the eastward, the sum or remainder will be the right ascension of the meridian.

4. From the right ascension of the meridian, increased by 24 hours if necessary, subtract the Sun's reduced right ascension; and the remainder will be the apparent time of observation at the meridian of the ship. Hence the error of the watch may be found.

NOTE. If the time at the ship or the longitude be not nearly known, then from the right ascension of the meridian subtract the Sun's right ascension for the nearest noon, and the remainder will be the time at the ship nearly; to this add the correction for the time from noon (XXII.) if the observation be taken in the morning, but subtract it if taken in the afternoon; likewise add the correction for longitude if the longitude be east, or subtract it if it be west; and the result will be the apparent time.

EXAMPLE I.

April 22, 1830, in latitude 42° 13′ N. and longitude 12° 42′ W. at 8h. 14m. 15s. per watch, the observed altitude of the Star Arcturus, being then east of the meridian, was 36° 57′, and the height of the eye was 24 feet: required the apparent time and error of the watch.

	°	′
Obs. alt. of Arcturus - -	36	57
Dip of horizon - - - -	—	5
Refraction - - -	—	1
True alt. of Arcturus - -	36	51

	h.	m.	s.
Sun's right ascen. April 22 -	1	58	38
Corr. for long. 12° 42′ W. -	+	0	7
Corr. for time, 8h.14m. aft. noon	+	1	17
Sun's reduced right ascension	2	0	2

	h.	m.	s.
Right Ascen. of Arcturus, 1820	14	7	27
Ann. Var. 2s 73 × 10⅓ = -	+		28
Reduced R. A. of Arcturus -	14	7	55

	°	′	″
Declin. of Arcturus, 1820 -	20	7	28 N
Ann. Var. 18″.99 × 10⅓ = -	—	3	16
Reduced declin. of Arcturus	20	4	12
	90		
Star's Polar distance -	69	55	48

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* The time of the principal Star's passing the meridian will be found in Table XV.

METHOD I.

	°	′		
True altitude -	36	51		
Polar distance -	69	56	- Co. secant -	0.02720
Latitude -	42	13	- Secant -	0.13041
Sum -	149	0		
Half sum -	74	30	- Co. sine -	9.42690
Remainder -	37	39	- Sine -	9.78593
			Const. Log. -	5.30103
	h. m. s.			
Dist. of Arcturus from meridian	3 51 48	East	- Log. rising -	4.67147

METHOD II.

	h.	m.	s.				
	°	′					
Co. Latitude - - -	47	47 N.				Co. secant	0.13041
Declination - - -	20	4 N.				Secant	0.02720
Meridian altitude - -	67	51		- Nat. sine	92620		
True altitude - -	36	51		- Nat. sine	59972		
				Difference	32648	- Log. -	4.51386
	h.	m.	s.				
Star's distance from meridian	3	51	48 East.			Log. rising	4.67147
Star's right ascension -	14	7	55				
Right ascen. of meridian -	10	16	7				
Sun's right ascension -	2	0	2				
Apparent time - -	8	16	5				
Time per watch - -	8	14	15				
Watch too slow - -		1	50				

EXAMPLE II.

January 5, 1830, in latitude 18° 20′ N., and longitude by account 55° 45′ West, the following altitudes of the Star Procyon were taken when it was west of the meridian; the observer's eye being 20 feet above the surface of the sea: required the apparent time and error of the watch.

	Times.			Altitudes.	
	h.	m.	s.	°	′
	16	41	30	26	15
		45	10	25	14
		48	25	24	29
		54	30	22	47
		59	13	21	17
5)		248	48	120	2
	16	49	45	24	0
	24				
	7	10	15		

Time before noon,
January 6th.

		°	′
Star's obs. altitude -		24	0
Dip of horizon -		—	4
Refraction - -		—	2
Star's true altitude -		23	54
	h.	m.	s.
Sun's R. A. Jan. 6	19	8	22
Corr. for long. -	+	0	41
Corr. for time -	—	1	19
Sun's red. R. Ascen.	19	7	44

	h.	m.	s.
Star's Rt. Ascen. 1820	7	29	53
Ann.var.$3^s.15 \times 10 = +$			32
Star's red. Rt. Ascen.	7	30	25
	°	′	″
Star's Declin. 1820	5	40	46
Ann.var.$8''.54 \times 10 = -$		1	25
Star's reduced Declin.	5	39	21
	90		
Star's Polar Distance	84	20	39

METHOD I.

	°	′			
True altitude	23	54			
Polar distance	84	21		Co. secant	0.00212
Latitude	18	20		Secant	0.02262
Sum	126	35			
Half sum	63	17½		Co. sine	9.65268
Remainder	39	23½		Sine	9.80251
				Const. Log.	5.30103
	h.	m.	s.		
Star's distance from meridian	4	26	40 West	Log. rising	4.78096

METHOD II.

	°	′					
Co. Latitude	71	40 N.				Co. secant	0.02262
Declination	5	39 N.				Secant	0.00212
Meridian altitude	77	19		Nat. sine	97560		
True altitude	23	54		Nat. sine	40514		
				Difference	57046	Log.	4.75623
	h.	m.	s.				
Star's distance from meridian	4	26	40 West.			Log. rising	4.78097
Star's right ascension	7	30	25				
Right ascen. of meridian	11	57	5 + 24h.				
Sun's right ascension	19	7	44				
Apparent time	16	49	21				
Time per watch	16	49	45				
Watch too fast		0	24				

To find the Error of a Watch by equal Altitudes of the Sun.

Rule.—1. In the morning, when the Sun is nearly east, or at least three or four points from the meridian, take several altitudes, and note the corresponding times that are shewn by the watch since the preceding noon. In the afternoon, observe when the Sun has the same altitudes, and note down the times opposite the respective altitudes, adding 24 hours to each. Take the means of the morning and afternoon times, add them together, and half their sum will be the middle of the times of observation; to this apply the equation of equal altitudes from Table XXXVI., and the result will be the time per watch when the Sun was on the meridian: the difference between which and 24 hours will be the error of the watch at apparent noon.

2. To find the error of the watch for mean time, apply the equation of time (taken from page II. of the Nautical Almanac, and reduced to the meridian of the ship by Table XXXVII.) to 24 hours, by addition or subtraction, as directed in the column from which it is taken, and the sum or remainder will be the mean time when the Sun is on the meridian; the difference between which and the time per watch at apparent noon, will be the error of the watch for mean time.

Note. This method of finding the error of a watch, and thereby regulating its going, is well adapted for practice on shore, where the altitudes may be taken with a Sextant by means of an Artificial Horizon*, and the corresponding times found with great exactness; and it is recommended in observing, to fix the Index of the Sextant to some particular division, and wait till the contact of the images takes place.

EXAMPLE I.

July 22, 1830, at Edinburgh, in latitude 55° 57′ N., and longitude 3° 12′ W., the following observations were made at equal altitudes of the Sun: required the error of the watch.

Alts. of Sun's low. l.		Times per watch A. M			Times per watch P. M.		
°	′	h	m	s	h	m	s
35	10	20	8	20	27	43	42
35	20		9	29		42	35
35	30		10	37		41	24
			28	26		127	41
Means		20	9	29	27	42	34
		27	42	34	20	9	29
Interval		7	33	5	47	52	3
		Middle time			23	56	1

Latitude	55° 57′	Tang.	10.17020
Equation to equal altitudes, first part (XXXVI.) to Sun's longitude 3 S. 29°, and interval 7h 33m	8s.87	Log.	0.94792
Reduced equation, first part	+ 13s.13	Log.	1.11812
second part	— 1 .82		
Equation to equal altitudes	+ 11 .31		
Middle time	23h 56m 1s		h m s
Time per watch at apparent noon	23 56 12		23 56 12
	24		
Watch too slow for apparent time	3 48		
Mean time at apparent noon			24 6 3
Watch too slow for mean time			9 51

EXAMPLE II.

April 10, 1830, at Bombay, in latitude 18° 56′ N. and longitude 72° 54′ E. the following equal altitudes of the Sun were observed: required the error of the watch.

Alts. of Sun's low. l.		Times per watch A. M.			Times per watch P. M.		
°	′	h	m	s	h	m	s
29	0	19	53	30	28	9	48
29	5		53	52		9	25
29	15		54	39		8	37
29	20		55	0		8	17
			217	1		36	7
Means		19	54	15	28	9	2
		28	9	2	19	54	15
Interval		8	14	47	48	3	17
		Middle time			24	1	38

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* For a description of the several kinds of Artificial Horizons, and the method of taking altitudes with them, see page 218.

				h	m	s
Latitude	$18^{\circ}\ 56'$	Tang.	9.53533			
Equation to equal altitudes, first part, (XXXVI.) to Sun's longitude 0 S. 20° and interval $8^{h}\ 15^{m}$	$17^{s}.31$	Log	1.23830			
Reduced equation, first part	— $5^{s}.94$	Log.	0.77363			
second part	+ 1 .10					
Equation to equal altitudes	— 4 .84					
Middle time	$24^{h}\ 1^{m}\ 38^{s}$					
Time per watch at apparent noon	24 1 33			24	1	33
	24					
Watch fast for apparent time	1 33					
Mean time at apparent noon				24	1	28
Watch fast for mean time						5

TO FIND THE LONGITUDE BY LUNAR OBSERVATIONS.

To find the apparent Altitudes and Distance.

Rule.—1. Turn the Ship's longitude by account into time (XIX.) and add it to the time at the ship if it be west, but subtract it if east; the sum or remainder will be the supposed time at Greenwich *, which call *reduced time.*

2. From page VII. of the month in the Nautical Almanac take out the Moon's horizontal parallax and semidiameter, and reduce them to the time of observation†; from Table VII. take a number of seconds answering to the observed altitude, which add to the Moon's reduced semidiameter, and their sum will be the Moon's augmented semidiameter.

3. If the Moon's lower limb be observed, add the semidiameter to the observed altitude, but if the upper limb be taken, subtract it; from the sum or remainder subtract the dip of the Horizon (V.) and the result will be the Moon's apparent altitude.

---

* In east longitude, when the longitude in time exceeds the time at the ship, add 24 hours to the latter, and subtract as before; then the remainder will be the time from noon of the preceding day.

In west longitude, when the sum of the longitude in time, and the time at the ship exceeds 24 hours, take 24 hours from it, and the remainder will be the time from noon of the following day.

† The Moon's horizontal parallax and semidiameter are reduced to the time of observation thus: take them out for the nearest noon and midnight, before and after the reduced time, and find their difference: then say, as 12 hours, is to the difference in 12 hours, so is the reduced time since the preceding noon or midnight, to a proportional part; which, being added to or subtracted from the horizontal parallax or semidiameter at the preceding noon or midnight, according as it is increasing or decreasing, will give them reduced to the time of observation. Or the proportional parts may be taken out by inspection from Table XLI. If the reduced time be near noon or midnight, the reduction will not be necessary, as may be seen in the first and second examples.

4. Then, *if the Sun be observed*, to the observed altitude of the lower limb add the semidiameter (taken from page III. of the month in the Nautical Almanac) and subtract the dip; the result will be the Sun's apparent altitude.

5. To the observed distance add the semidiameters of the Sun and Moon: their sum will be the apparent distance.

6. But, *if a Star be observed*, from its observed altitude subtract the dip, and the remainder will be the Star's apparent altitude.

7. To the observed distance of the Moon and Star, add the Moon's semidiameter, if the nearest limb was taken, but subtract it if the farthest limb was observed: their sum or difference will be the apparent distance.

*To find the true Distance**.

METHOD I.

Rule.—1. To the correction of the Moon's altitude (XXX.) add the correction of the Sun or Star's altitude †; their sum, added to the difference of the apparent altitudes, when the Moon's altitude is greater, or subtracted from it, when the Moon's altitude is less than the Sun or Star's, will give the difference of their true altitudes.

2. From the natural co-sine of the difference of the apparent altitudes (XXVI.) subtract the natural co-sine of the apparent distance, when the apparent distance is less than 90°; but when it is greater, add together the natural co-sines; and to the logarithm of this sum or remainder (XXIV.) add the logarithmic difference (XXXI.:) then, the difference between the natural number of this sum and the natural co-sine of the difference of the two altitudes, will be the natural co-sine of the true distance, when the natural number is less than the natural co-sine of the difference of the two altitudes; otherwise the remainder will be the natural co-sine of the supplement of the true distance, or the natural sine of the excess of the true distance above 90°.

METHOD II.

Rule.—1. To the sum of the apparent altitudes add the difference of the correction of the Moon's altitude (XXX.) and that of the Sun or Star's altitude†, which will give the sum of the true altitudes, of which take the half.

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* Five different methods of clearing the distance are here given: the first is Mr. Dunthorne's; the second is derived from that of M. Borda, abridged by the Table of Logarithmic differences; both requiring six places of figures; the third is similar to that given by Mr. Witchell, and requires only four places of figures; the fourth was invented by Mendoza Rios, Esq. and has the peculiar advantage of not requiring any distinction of cases; the fifth is Mr. Lyons', improved by using a set of Linear Tables invented and published by the author of this work. These Tables, for correcting the apparent distance for the effect of refraction without calculation, render this method one of the easiest and shortest that have been proposed.

† The Sun's correction is the difference of the refraction and parallax in altitude (IV. VI.) The Star's correction is the refraction in altitude (IV.)

2. Add together the apparent altitudes and apparent distance, and find the difference between half this sum and the apparent distance.

3. To the log. co-sines of the half sum and difference (XXV.) add the logarithmic difference (XXXI.) and half the sum of these three logarithms will be the log. sine of an arch.

4. Add together the log. co-sines of the sum and difference of the arch, and half the sum of the true altitudes; then will half the sum of these two logarithms be the log. sine of half the true distance.

Note. In the preceding methods it may be observed that the seconds of the apparent distance may be omitted until the operation is finished, and then they are to be added to the computed distance. If the sum of the apparent distance and altitudes should have an odd digit in the units place of the minutes, the minutes in the distance may be increased by an unit; and, in this case, what the given number of seconds wants of 60″, are to be subtracted from the computed distance.

METHOD III.

Rule.—1. Add the Sun or Star's and the Moon's apparent altitudes together, and take half their sum; subtract the less from the greater, and take half the difference; then add together,

the log. co-tangent of half the sum (XXV.)
the log. tangent of half the difference;
and the log. co-tangent of half the apparent distance:

their sum, rejecting the tens in the Index, will be the log. tangent of an arch, which call A.

2. When the Sun or Star's altitude is greater than the Moon's, take the difference between the arch A and half the apparent distance; but if less, take their sum; then add together,

the log. co-tangent of this sum or difference;
the log. co-tangent of the Sun or Star's apparent altitude;
and the proportional logarithm (XXXIV.) of the Sun or Star's correction*; their sum, rejecting the tens in the index, will be the proportional logarithm of the first correction.

Or, the refraction (IV.) answering to the complement of the abovementioned sum or difference will be the first correction nearly.

3. If the sum of the arch A, and half the apparent distance, was taken in the preceding article, now take their difference; but if their difference was then taken, now take their sum; then add together,

the log. co-tangent of this sum or difference;
the log. co-tangent of the Moon's apparent altitude•
and the proportional log. (XXXIV.) of the Moon's correction (XXX.) their sum, rejecting the tens in the index, will be the proportional logarithm of the second correction.

---

* The Sun's correction is the difference of the refraction and parallax in altitude (IV. VI.) The Star's correction is the refraction in altitude (IV.)

4. When the arch A is less than half the apparent distance, the first correction must be added to, and the second correction subtracted from the apparent distance; but when the arch A is greater, both the first and second corrections are to be added to the apparent distance, if the Moon's altitude is the greater; but when the Moon's altitude is the less, they are both to be subtracted from it, to give the corrected distance.

5. Enter Table XXXV. with the corrected distance at the top or bottom, and the Moon's correction and second correction alternately in the side column: the difference between the number of the seconds thus taken out being added to the corrected distance, when it is less than 90°, or subtracted from it when above, will give the true distance.

METHOD IV.

Rule.—1. Add together the apparent distance and apparent altitudes, and take half their sum; the difference between the half sum and the Sun or Star's apparent altitude call the first remainder: and the difference between the half sum and the Moon's apparent altitude call the second remainder.

2. Add together,
the log. sine of the apparent distance;
the log. co-sine of the Moon's apparent altitude;
the log. secant of the half sum;
the log. co-secant of the first remainder;
the proportional log. (XXXIV.) of the Moon's correc. (XXX.)
and the constant logarithm 9.6990;
their sum, rejecting the tens in the index, will be the proportional logarithm of the first correction.

3. Add together,
the log. sine of the apparent distance (already found;)
the log. co-sine of the Sun or Star's apparent altitude;
the log. secant of the half sum (already found;)
the log. co-secant of the second remainder;
the proportional log. (XXXIV.) of the Sun or Star's correc. *;
and the constant logarithm 9.6990.
their sum, rejecting the tens in the index, will be the proportional logarithm of the second correction.

4. The difference between the first correction and the correction of the Moon's altitude, call the difference of corrections.

Enter Table XXXV. with the apparent distance at the top, and the Moon's correction in the side column, the corresponding number will be the third correction; in the same column, and opposite the difference of corrections, will be found the fourth correction.

5. Subtract the sum of the Moon's correction, and the second and fourth corrections, from the apparent distance; to the remainder add

* The Sun's correction is the difference of the refraction and parallax in altitude (IV. VI.) The Star's correction is the refraction in altitude (IV.)

the Sun or Star's correction, and the first and third corrections; their sum will be the true distance.

METHOD V.

1. To the apparent distance add the correction taken from the Linear Tables; the sum will be the distance corrected for refraction.

2. Add together the sine of the corrected distance (XXV.), the co-secant of the Sun or Star's apparent altitude, and the proportional logarithm (XXXIV.) of the Moon's horizontal parallax; the sum, rejecting 20 in the index, will be the proportional logarithm of the *first arch.*

3. Add together the tangent of the corrected distance, the co-secant of the Moon's apparent altitude, and the proportional logarithm of the Moon's horizontal parallax; the sum, rejecting 20 in the index, will be the proportional logarithm of the *second arch.*

4. *When the distance is less than* 90°, the difference of the first and second arches is a *correction for parallax,* which, subtracted from the corrected distance when the first arch is the greater, or added to it when the first arch is the less, the sum or remainder will be the distance corrected for the Moon's parallax.

But, *when the distance is greater than* 90°, the sum of the two arches is a *correction for parallax,* and is always to be subtracted from the corrected distance.

5. Enter Table XXXV. with the distance at the top, and the Moon's parallax in altitude* in the left side column, and take out a number of seconds answering thereto; in the same column, opposite the correction for parallax, find another number of seconds; the difference between these being added to the distance corrected for refraction and parallax, when it is less than 90°, or subtracted from it when above, the sum or remainder will give the true distance.

Having the true Distance to find the Longitude.

Rule.—1. Among the true distances of the Moon's center from the Sun or fixed Stars, set down in pages VIII, IX, X, and XI, of each month in the Nautical Almanac, find those two distances on the given day that are next less and greater than the true distance found by the observation, which place under it: take the difference between the true distance and the first of these two distances, also the difference between the two distances; subtract the proportional logarithm of the second difference from the proportional logarithm of the first difference, and the remainder will be the proportional logarithm of a portion of time, which added to the time that the first of the two distances, taken from the Almanac, was computed for, the sum will be the apparent time at Greenwich.

---

* The Moon's parallax in altitude is found by Table B. (Linear Tables), under the Moon's horizontal parallax, and opposite the Moon's altitude.

2. Take the difference between the apparent time at Greenwich and the apparent time at the Ship* ; convert it into degrees and minutes (XIX.) and it will give the true longitude of the Ship; East, if the time at the Ship be greater than the time at Greenwich (reckoned from the same noon), but West if the time at the Ship be less than the time at Greenwich.

EXAMPLE I.

May 28, 1830, in latitude 23° 30′ N. and longitude by account 59° E., about 4h. 0m. P. M. the angular distance of the Sun and Moon was observed to be 79° 7′ 25″, the altitude of the Sun's lower limb being 35° 35′, the altitude of the Moon's upper limb 64° 12′, and the height of the eye 18 feet: required the true longitude of the Ship.

	h. m.		′ ″		′ ″
Time at ship -	4 0	☽'s hor. par. at noon	55 36	☽'s semid. at noon	15 9
Long. in time -	3 56 E.			Augmentation	+ 14
Reduced time -	0 4	Obs. alt. ☽'s upper limb	64° 12′	☽'s aug. semid.	+ 15 23
	° ′	☽'s aug. semid. — 15′ 23″ Dip of hor. — 4 4	— 19	☉'s semidiam.	+ 15 48
Obs. alt. ☉'s l. limb	35 35			Obs. distance	79 7 25
☉'s semid. + 15′ 48″ Dip of hor. — 4 4	+ 12	☽'s apparent altitude	63 53	App. distance	79 38 36
Sun's app. alt. -	35 47				

To find the True Distance.

METHOD I.

Apparent distance -	79° 38′	Nat. co. sine -	179947		
Moon's app. altitude	63 53				
Sun's app. altitude -	35 47				
Diff. app. altitudes -	28 6	Nat. co. sine -	882127		
				Log. diff.	9.993868
Moon's corr. 24′ 00″ Sun's corr. 1 12	+ 25 12″	Difference -	702180	Log. -	5.846449
		Nat. number -	692337	Log. -	5.840317
Diff. true altitudes -	28 31 12	Nat. co. sine -	878650		
	79 15 44	Nat. co. sine -	186313		
Seconds omitted - -	+ 36				
True distance - - -	79 16 20				

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* If the Sun, or the Star from which the Moon's distance is computed, be far enough from the meridian when the distance was observed, the time at the Ship is to be found from its altitude by the Rules in page 226 or 230, but if the object be too near the meridian, or the altitude taken with the distance cannot well be depended on, (although it may be sufficiently exact for clearing the distance) the time at the Ship, and thence the error of the watch, must be found either before or after the distance is taken, and the error applied to the mean of the times given by the same watch, when the distance is observed (as in the third and fourth examples); and it must be understood that in this case the longitude deduced from the lunar observation will be that of the Ship, at the time the error of the watch was ascertained.

METHOD II.

	° ′		° ′		
Moon's app. altitude	63 53		63 53		
Sun's app. altitude	35 47		35 47		
		App. distance	79 38		
Sum of app. altitudes	99 40	Sum	179 18	Log. diff.	9.993868
Moon's corr. 24′ 00″ Sun's corr. 1 12	+ 22 48	Half	89 39	Co. sine	7.785943
		Difference	10 1	Co. sine	9.993329
Sum of true altitudes	100 2 48				17.773140
Half	50 1 24				
Arch	4 25 1			Sine	8.886570
Sum	54 26 25			Co. sine	9.764588
Difference	45 36 23			Co. sine	9.844840
					19.609428
	39 37 52			Sine	9.804714
	× 2				
	79 15 44				
Seconds omitted	+ 36				
True distance	79 16 20				

METHOD III.

	° ′				
Moon's app. altitude	63 53				
Sun's app. altitude	35 47		° ′		
Sum	99 40	Half	49 50	Co. tan.	9.9264
Difference	28 6 ″	Half	14 3	Tangent	9.3984
App. distance	79 38 36	Half	39 49	Co. tan.	10.0790
First correction	+ 1 12				
		Arch A.	14 13	Tangent	9.4038
	79 39 48				
Second correction	− 23 27	Sum	54 2	Co. tan.	9.8607
		Sun's app. alt.	35 47	Co. tan.	10.1422
	79 16 21	Sun's correction	1′ 12″	P. Log.	2.1761
Third correction	0				
		First correction	1 12	P. Log.	2.1790
True distance	79 16 21				
		Difference	25° 36′	Co. tan.	10.3196
		Moon's app. alt.	63 53	Co. tan.	9.6904
		Moon's correction	24′ 00″	P. Log.	0.8751
		Second correction	23 27	P. Log.	0.8851

METHOD IV.

	° ′					° ′ ″
App. distance	79 39	Sine	9.9929	9.9929	Moon's corr.	— 24 00
Moon's app. alt.	63 53	Co. sine	9.6437		Second corr.	— 0
Sun's app. alt.	35 47	Co. sine		9.9091	Fourth corr.	— 1
Sum	179 19				Sum	— 24 1
					App. distance	79 38 36
Half	89 39	Secant	2.2141	2.2141		
First remainder	53 52	Co. secant	0.0928			79 14 35
Second remainder	25 46	Co. secant		0.3618	Sun's corr.	+ 1 12
Sun's correction	1′ 12″	P. Log.		2.1761	First corr.	+ 0 33
Moon's correction	24 0	P. Log.	0.8751		Third corr.	+ 1
		Const. Log.	9.6990	9.6990		
					True distance	79 16 21
First correction	0 33	P. Log.	2.5176	P.L. 4.3530	Second corr. 0″	
Diff. of corr.	23 27					

METHOD V.

	° ′ ″				
App. distance	79 38 36				
Corr. for refraction	+ 1 46				
Corrected distance	79 40 22	Sine	9.9929	Tangent	0.7391
Sun's app. altitude	35 47	Co. secant	0.2331		
Moon's app. altitude	63 53	Co. secant			0.0468
Moon's hor. parallax	55 36	Pro. Log.	0.5102		0.5102
First arch	33 3	Pro. Log.	0.7362		
Second arch	9 6			Pro. Log.	1.2961
Corr. for parallax	— 23 57				
Corrected distance	79 40 22				
	79 16 25				
Third correction	0				
True distance	79 16 25				

To find the Longitude of the Ship.

	° ′ ″		° ′ ″	
True distance (by Method v.)	79 16 25	First diff.	0 2 8	Pro. Log. 1.9262
Distance at noon	79 14 17	Second diff.	1 25 50	Pro. Log. 0.3216
Distance at 3 hours	80 40 7			

	h. m. s.	
Proportional part	0 4 28	Pro. Log. 1.6046
Time of first distance	0 0 0	
App. time at Greenwich	0 4 28	

	° ′ ″
Sun's declin. May 28, at noon, by N.A.	21 25 38 N.
	90
Sun's polar distance	68 34 22

	° ′		
Sun's app. altitude	35 47		
Refraction	— 1		
Sun's true altitude	35 46		
Sun's polar distance	68 34	Co. secant	0.03112
Ship's latitude	23 30	Secant	0.03760
Sum	127 50		
Half	63 55	Co. sine	9.64314
Remainder	28 9	Sine	9.67374
		Const. Log.	5.30103
	h. m. s.		
App. time at Ship	3 56 17	Rising	4.68663
App. time at Greenwich	0 4 28		
Longitude in time	3 51 49 = 57° 57′ 15″ East.		

EXAMPLE II.

August 6, 1830, in latitude 47° 10′ S., and longitude by account 28° 45′ W. about 10h. P. M. the distance of the Moon's remote limb from the Star Antares was observed to be 99° 37′ 50″; at the same time the altitude of the Moon's lower limb was 23° 8′, the altitude of the Star (being westward of the meridian) was 51° 4, and the height of the eye 16 feet: required the true longitude of the Ship.

	h. m.		′ ″		′ ″
Time at ship -	10 00	☽'s hor. par. at midn.	59 25	☽'s semid. at midn.	16 11
Long. in time -	1 55W.			Augmentation	+ 7
Reduced time -	11 55	Obs. alt. ☽'s lower limb	23° 8′	☽'s aug. semid. —	16 18
	° ′	☽'s aug. semid. + 16′ 18″ } Dip of hor. — 3 50 }	+ 12	Obs. distance	99 37 50
Star's obs. altitude	51 4				
Dip of hor. - -	— 4			App. distance	99 21 32
		☽'s apparent altitude	23 20		
Star's app. altitude	51 0				

To find the True Distance

METHOD I.

	° ′				
Apparent distance -	99 21	Nat. co. sine -	162465		
Moon's app. altitude	23 20				
Star's app. altitude -	51 0				
Diff. of app. altitudes	27 40	Nat. co. sine -	885664		
				Log. diff.	9.997207
Moon's corr. 52′ 22″ } Star's corr. 46 }	— 53 8″	Sum - - -	1048129	Log. -	6.020415
		Nat. number -	1041411	Log. -	6.017622
Diff. of true altitudes	26 46 52	Nat. co. sine -	892736		
	98 33 1	Nat. co. sine -	148675		
Seconds omitted - -	+ 32				
True distance - - -	98 33 33				

METHOD II.

	° ′		° ′		
Moon's app. altitude	23 20	- - - - - - - -	23 20		
Star's app. altitude -	51 00	- - - - - - - -	51 00		
		App. distance -	99 22		
Sum of app. altitudes	74 20				
Moon's corr. 52′ 22″ } Star's corr. 46 }	+ 51 36″	Sum - - - -	173 42	Log. diff.	9.997207
		Half - - - -	86 51	Co. sine	8.739969
		Difference - -	12 31	Co. sine	9.989553
Sum of true altitudes	75 11 36				
Half - - - - -	37 35 48				18.726729
Arch - - - - - -	13 20 54	- - - - - - - - - -		Sine -	9.363364
Sum - - - - -	50 56 42	- - - - - - - - - -		Co. sine	9.799386
Difference - - -	24 14 54	- - - - - - - - - -		Co. sine	9.959887
					19.759273
	49 17 00	- - - - - - - - - -		Sine -	9.879636
	× 2				
	98 34 00				
Second increased -	— 28				
True distance - -	98 33 32				

METHOD III.

	° ′		° ′		
Moon's app. altitude	23 20				
Star's app. altitude -	51 00				
Sum - - - - - -	74 20	Half - - - -	37 10	Co. tan.	10.1203
Difference - - - -	27 40	Half - - - -	13 50	Tangent	9.3914
App. distance - -	99 21 32	Half - - - -	49 41	Co. tan.	9.9287
First correction - -	+ 39				
		Arch A. - - -	15 25	Tangent	9.4404
	99 22 11				
Second correction -	— 48 39	Difference - - -	34 16	Co. tan.	10.1667
		Star's app. alt. -	51 00	Co. tan.	9.9084
	98 33 32	Star's correction -	0′ 46″	P. Log.	2.3707
Third correction -	0				
		First correction -	0 39	P. Log.	2.4458
True distance - -	98 33 32				
		Sum - - - -	65° 6′	Co. tan.	9.6667
		Moon's app. alt. -	23 20	Co. tan.	10.3652
		Moon's correction	52′ 22″	P. Log.	0.5362
		Second correction	48 39	P. Log.	0.5681

METHOD IV.

	° ′					° ′ ″
App. distance	99 22	Sine -	9.9942	9.9942	Moon's corr.	— 52 22
Moon's app. alt.	23 20	Co. sine	9.9629		Second corr.	— 7
Star's app. alt.	51 00	Co. sine - - - -		9.7989	Fourth corr.	— 16
Sum - - -	173 42				Sum - -	— 52 45
					App. distance	99 21 32
Half - - -	86 51	Secant -	1.2600	1.2600		
First remainder	35 51	Co. secant	0.2324			98 28 47
Second remainder	63 31	Co. secant - - - -		0.0481	Star's corr.	+ 0 46
Star's correction	0′ 46″	P. Log. - - - -		2.3707	First corr.	+ 3 43
Moon's correction	52 22	P. Log. -	0.5362		Third corr.	+ 0 16
		Const. Log.	9.6990	9.6990		
					True distance	98 33 32
First correction	3 43	P. Log.	1.6847	P.L. 3.1709	Second corr. 7″	
Diff. of corrections	48 39					

METHOD V.

	° ′ ″				
App. distance - -	99 21 32				
Corr. for refraction	+ 2 42				
Corrected distance	99 24 14	Sine - - - - -	9.9941	Tangent	0.7811
Star's app. altitude	51 00	Co. secant - - -	0.1095		
Moon's app. altitude	23 20	Co. secant - - - - - -			0.4022
Moon's hor. parallax	59 25	Pro. Log. - - -	0.4814		0.4814
Arch first - - -	46 48	Pro. Log. - - -	0.5850		
Arch second - -	3 54			Pro. Log.	1.6647
Corr. for parallax -	— 50 42				
Corrected distance	99 24 14				
	98 33 32				
Third correction -	— 0				
True distance - -	98 33 32				

To find the Longitude of the Ship.

	° ′ ″		° ′ ″		
True Distance (by Method v.)	98 33 32	First diff.	1 39 57	Pro. Log.	2555
Distance at 9 hours	96 53 35	Second diff.	1 45 36	Pro. Log.	2316
Distance at 12 hours	98 39 11				

	h. m. s.		
Proportional part	2 50 22	Pro. Log.	0239
Time of first distance	9 0 0		
App. time at Greenwich	11 50 22		

	° ′
Star's app. altitude	51 00
Refraction	— 1
Star's true altitude	50 59

	h. m. s.
Star's right ascension, 1820	16 18 22
Ann. variation + 3s.66 × 10½ =	+ 38
Star's right ascension, Aug. 1830	16 19 00

	h. m. s.
Sun's right ascension, Aug. 6	9 3 40
Corr. for Greenwich time, 11h. 50m. past noon	+ 1 53
Sun's reduced right ascension	9 5 33

	° ′ ″
Star's declination, 1820	26 1 16 S.
Ann. variation + 8″.62 × 10½ =	+ 1 31
Star's declination, Aug. 1830	26 2 47 S.
	90
Polar distance	63 57 13

	° ′		
Star's true altitude	50 59		
Star's polar distance	63 57	Co. secant	0.04653
Ship's latitude	47 10	Secant	0.16758
Sum	162 6		
Half sum	81 3	Co. sine	9.19193
Remainder	30 4	Sine	9.69984
		Const. Log.	5.30103
	h. m. s.		
Star's distance from meridian	2 47 26 W.	Rising	4.40691
Star's right ascension	16 19 00		
Right ascension of meridian	19 6 26		
Sun's right ascension	9 5 33		
Apparent time at Ship	10 0 53		
Apparent time at Greenwich	11 50 22		
Longitude in time	1 49 29 = 27° 22′ 15″ West.		

EXAMPLE III.

September 7, 1830, in latitude 47° 45′ N., and longitude by account 127° W. the following sets of observations were taken, in order to determine the true longitude: the height of the eye being 20 feet, the watch not regulated, but the errors of the instruments previously ascertained.

	Times. h.	m.	s.	Alt. ☉'s l. limb. °	′	″	Alt. ☽'s up. limb. °	′	″	Distances. °	′	″	
	23	8	45	46	43	0	7	29	15	100	5	22	
		10	10		49	15	7	10	0		4	37	
		11	17		54	30	6	55	30		4	5	
		12	23		56	15	6	42	0		3	10	
		13	10		59	0	6	31	0		2	50	
	5)	55	45		262	0	34	47	45		20	4	
Means -	23	11	9	46	52	24	6	57	33	100	4	1	
				+	1	30	—	1	10	—	0	15	Ind. Errs.
				46	53	54	6	56	23	100	3	46	

	h.	m.
Time at ship -	23	11
Long. in time -	8	28
Reduced time -	31	39
	24	
Ditto, September 8,	7	39

	°	′
Obs. alt. ☉'s l. limb	46	54
☉'s semid. + 15′ 55″ } Dip of hor. — 4 17 }	+	12
Sun's app. altitude	47	6

	′	″
Moon's hor. par. at noon	59	20
Ditto at midnight - -	59	2
Difference in 12 hours		18
12h. : 18″ : : 8h. :		12
Moon's hor. par. at noon	59	20
Moon's reduced hor. par.	59	8

	°	′
Obs. alt. ☽'s upper limb	6	56
☽'s aug. semid. — 16′ 9″ } Dip of hor. — 4 17 }	+	20
Moon's app. altitude	6	36

		′	″
Moon's semid. at noon		16	10
Ditto at midnight -		16	5
Difference in 12 hours			5
12h. : 5″ : : 8h. :			3
Moon's semid. at noon		16	10
Moon's reduced semid.		16	7
Augmentation - -		+	2
Moon's aug. semid.		+ 16	9
Sun's semidiam.		+ 15	55
Obs. distance -	100°	3	46
App. distance -	100	35	50

To find the True Distance.

METHOD III.

	°	′	″
Moon's app. altitude	6	36	
Sun's app. altitude -	47	6	
Sum - - - - -	53	42	
Difference - - -	40	30	
Apparent distance -	100	35	50
First correction - -		+	18
	100	36	8
Second correction -		— 39	24
	99	56	44
Third correction -		—	2
True distance - -	99	56	42

	° ′		
- Half - - - - -	26 51	- Co. tan.	10.2957
- Half - - - - -	20 15	- Tangent	9.5669
- Half - - - - -	50 18	- Co. tan.	9.9192
Arch A. - - -	31 11	- Tangent	9.7818
Difference - - -	19 7	- Co. tan.	10.4602
Sun's app. alt. -	47 6	- Co. tan.	9.9681
Sun's correction -	0′ 47″	- P. Log.	2.3613
First correction -	0 18	- P. Log.	2.7896
Sum - - - - -	81° 29′	- Co. tan.	9.1754
Moon's app. alt. -	6 36	- Co. tan.	10.9367
Moon's correction	50′ 59″	- P. Log.	0.5478
Second correction	39 24	- P. Log.	0.6599

METHOD IV.

	° ′					° ′ ″
App. distance	100 36	Sine	9.9925	9.9925	Moon's corr.	— 50 59
Moon's app. alt.	6 36	Co. sine	9.9971		Second corr.	— 29
Sun's app. alt.	47 6	Co. sine		9.8330	Fourth corr.	— 18
Sum	154 18				Sum	— 51 46
					App. distance	100 35 50
Half sum	77 9	Secant	0.6529	0.6529		
First remainder	30 3	Co. secant	0.3004			99 44 4
Second remainder	70 33	Co. secant		0.0255	Sun's corr.	+ 47
Sun's correction	0′ 47″	P. Log.		2.3613	First corr.	+ 11 38
Moon's correction	50 59	P. Log.	0.5478		Third corr.	+ 16
		Const. Log.	9.6990	9.6990		
					True distance	99 56 45
First correction	11 38	P. Log.	1.1897	P.L. 2.5642	Second corr. 29″	
Diff. of corr.	39 21					

METHOD V.

	° ′ ″				
App. distance	100 35 50				
Corr. for refraction	+ 6 16				
Corrected distance	100 42 6	Sine	9.9924	Tangent	0.7236
Sun's app. altitude	47 6	Co. secant	0.1352		
Moon's app. altitude	6 36	Co. secant			0.9395
Moon's hor. parallax	59 8	Pro. Log.	0.4834		0.4834
First arch	44 5	Pro. Log.	0.6110		
Second arch	1 17			Pro. Log.	2.1465
Corr. for parallax	— 45 22				
Corrected distance	100 42 6				
	99 56 44				
Third correction	— 2				
True distance	99 56 42				

To find the Longitude of the Ship.

	° ′ ″		° ′ ″		
True Distance (by Method v.)	99 56 42	First diff.	0 53 28	Pro. Log.	5272
Distance at 6 hours	100 50 10	Second diff.	1 38 26	Pro. Log.	2621
Distance at 9 hours	99 11 44				
			h. m. s.		
		Proportional part	1 37 46	Pro. Log.	2651
		Time of first distance	6		
		App. time at Greenwich, Sept. 8	7 37 46		
			24		
		App. time at Greenwich, Sept. 7	31 37 46		

The Sun being too near the meridian at the time of taking the distances, to infer the time from its altitude, the following observations were made in the afternoon, in order to determine the error of the watch: the latitude of the Ship being then 47° 8′ N., the longitude by account 126° 17′ W., and the error of the Sextant 1′ 10″ to add.

Times. h. m. s.	Alt. ⊙'s l.limb. ° ′ ″		° ′ ″		° ′ ″
4 8 15	22 40 0	Obs. alt. ⊙'s l. limb	22 12 1	⊙'s declin. Sept. 8,	5 48 18 N.
9 30	22 24 0	⊙'s semid. + 15′ 55″ }	+ 11 38	Corr. for long. -	— 8 0
10 26	22 13 30	Dip of hor. — 4 17 }		Corr. for time -	— 4 0
12 0	21 54 45				
13 19	21 42 0	Sun's app. altitude	22 23 39	Sun's red. declin.	5 36 18
		Refraction - - -	— 2 18		90
53 30	110 54 15				
		Sun's true altitude	22 21 21	⊙'sPolar distance	84 23 42
4 10 42	22 10 51 Means.				
	+ 1 10 Index Error.				
	22 12 1				

	° ′		
Sun's true altitude - -	22 21		
Sun's polar distance -	84 24	Co. secant -	0.00208
Ship's latitude - - -	47 8	Secant - -	0.16730
Sum - - - - - -	153 53		
Half sum - - - -	76 56½	Co. sine - -	9.35400
Remainder - - - -	54 35½	Sine - - -	9.91118
		Const. Log. -	5.30103
	h. m. s.		
App. time at Ship, Sept. 8	4 11 29	Rising - -	4.73559
Time per Watch - - -	4 10 42		
Watch too slow - - - -	+ 0 47		
Time of obs. dist. per Watch	23 11 9		
App. time of obs. dist. at Ship, Sept. 7 - - -	23 11 56		
App. time at Greenwich, past noon, Sept. 7 -	31 37 46		
Longitude in time - - -	8 25 50 = 126° 27′ 30″ West.		

NOTE. The above is the longitude of the Ship at 4h. 11m. 29s. P. M., the time when the error of the watch was found, and is to be reduced to noon, or any other time, by the log.

Thus, suppose it were required to find the Longitude of the Ship when the distances were observed. By comparing the longitudes by account at both observations, it appears that the ship has made 43 miles of longitude to the east; which, therefore, added to 126° 27′ 30″ W., the longitude when the altitudes were observed for time, gives the longitude 127° 10′ 30″ W. when the distances were taken.

EXAMPLE IV.

March 12, 1830, in latitude 36° 7′ S., and longitude by account 34° E. the following observations of the Sun's lower limb were taken, the height of the eye being 18 feet, the error of the quadrant 3′ to be subtracted: required the error of the Watch.

Times.	Alt. ☉'s l.limb.				
h. m. s.	° ′ ″		° ′ ″		° ′ ″
4 41 30	16 55	Obs. alt. ☉'s l. limb	16 22 12	☉'s declin. Mar. 12,	3 23 40 S.
42 56	16 38	☉'s semid. + 16′ 7″ }	+ 12 3	Corr. for long. 34° E.	+ 2 12
44 5	16 24	Dip of hor. — 4 4 }			
45 15	16 10			h.m.	3 25 52
46 9	15 59	Sun's app. altitude	16 34 15	Corr. for time 4 44 P.M.	— 4 35
		Refraction - - -	— 3 9		
5)219 55	82 6			Sun's red. declin. -	3 21 17
		Sun's true altitude	16 31 6		
4 43 59	16 25 12				
	— 3 0	Index Error.			
	16 22 12				

	° ′				
Co. latitude - - - - - - -	53 53 S.	- - - - - - -		Co. secant	0.09269
Declination - - - - - - -	3 21 S.	- - - - - - -		Secant -	0.00074
Meridian altitude - - - -	57 14	- Nat. sine	84088		
True altitude - - - - -	16 31	- Nat. sine	28429		
		Difference	55659	- Log. -	4.74553
	h. m. s.				
Apparent time at Ship - - -	4 47 49	- - - - - - - - -		Rising -	4.83896
Time per Watch - - - - -	4 43 59				
Watch too slow - - - - -	3 50				

In the Evening the following observations were made of the Moon and the Star Regulus: required from thence the true longitude of the Ship at the time the error of the watch was ascertained.

	Times.	Alt. ☽'s l. limb.	Alts.* Regulus.	Dist. ☽'s far. l.	
	h. m. s.	° ′ ″	° ′ ″	° ′ ″	
	9 33 30	18 56 0	39 55 0	60 14 20	
	35 14	19 19 0	40 2 0	15 10	
	36 50	19 44 0	40 10 0	16 5	
	38 17	20 1 0	40 14 0	16 40	
	40 19	20 35 0	40 23 0	17 35	
	5) 184 10	98 35 0	200 44 0	79 50	
Means - - - -	9 36 50	19 43 0	40 8 48	60 15 58	
Error of Watch	+ 3 50	+ 2 0	— 3 20	— 0 30	Ind. Errs.
App. time at Ship	9 40 40	19 45 0	40 5 28	60 15 28	

	h. m.		′ ″		′ ″
Time at ship -	9 41	Moon's hor. par. at noon	53 59	Moon's semid. at noon	14 43
Long. in time -	2 16 E.	Ditto at midnight - -	54 1	Ditto at midnight -	14 43
Reduced time -	7 25	Difference in 12 hours	2	Difference in 12 hours	0

	°	′	″
*'s obs. altitude	40	5	28
Dip of hor. -	—	4	4
*'s app. altitude	40	1	24

h. 12 : 2″ :: h. 7 : + 1″

	′	″
Moon's hor. par. at noon	53	59
Ditto at reduced time	54	0

		°	′	″
Obs. alt. ☽'s lower limb		19	45	0
☽'s aug. semid.	+ 14′ 49″	+	10	45
Dip of hor.	— 4 4			
Moon's app. altitude -		19	55	45

h. 12 : 0″ :: h. 7 : 0″

	°	′	″
Moon's semid. at noon		14	43
Ditto at reduced time		14	43
Augmentation - -		+	6
☽'s augm. semid. - -		14	49
Obs. distance -	60	15	28
App. distance -	60	0	39

METHOD IV.

	° ′			
App. distance	60 1	Sine -	9.9376	9.9376
Moon's app. alt.	19 56	Co. sine	9.9732	
Star's app. alt.	40 1	Co. sine - - - -		9.8841
Sum - - -	119 58			
Half sum - -	59 59	Secant -	0.3008	0.3008
First remainder	19 58	Co. secant	0.4666	
Second remainder	40 3	Co. secant - - - -		0.1915
Star's correction	1′ 8″	P. Log. - - - -		2.2009
Moon's correction	48 10	P. Log. -	0.5725	
		Const. Log.	9.6990	9.6990
First correction	20 13	P. Log.	0.9497	P.L 2.2139
Diff. of corr. -	27 57			

	°	′	″
Moon's corr.	—	48	10
Second corr.	—	1	6
Fourth corr.	—		4
Sum - - -	—	49	20
App. distance	60	0	39
	59	11	19
Star's corr.	+	1	8
First corr.	+	20	13
Third corr.	+		12
True distance	59	32	52
Second corr. 1′ 6″			

METHOD V.

	°	′	″				
App. distance - -	60	0	39				
Corr. for refraction	+	1	32				
Corrected distance	60	2	11	Sine - - - - -	9.9377	Tangent	0.2391
Star's app. altitude	40	1		Co. secant - - -	0.1918		
Moon's app. altitude	19	56		Co. secant - - -			0.4673
Moon's hor. parallax		54	0	Pro. Log. - - -	0.5229		0.5229
First arch - - -		40	5	Pro. Log. - - -	0.6524		
Second arch - -		10	37			Pro. Log.	1.2293
Corr. for parallax -	—	29	28				
Corrected distance	60	2	11				
	59	32	43				
Third correction -		+	9				
True distance - -	59	32	52	First diff.	0° 43′ 49″	Pro. Log.	6136
Distance at 6 hours	58	49	3	Second diff.	1 28 35	Pro. Log.	3079
Distance at 9 hours	60	17	38				

	h. m. s.		
Proportional part - - -	1 29 2	Pro. Log.	3057
Time of first distance - -	6		
App. time at Greenwich	7 29 2		
App. time at ship - - -	9 40 40		

Long. in time at the place where the Sun's altitudes were observed to find the error of the Watch - } 2 11 38 = 32° 54′ 30″ East.

When the time under the meridian of the Ship cannot be found from altitudes taken with the distances, as is the case in the third and fourth Examples, the observer may, instead of finding the error of the watch by altitudes taken before or after the distances, note the times by a Chronometer at both observations, by which he will obtain the time elapsed between those observations; this applied to the apparent time at the ship when altitudes were observed for time, will shew the time under that meridian when the distances were taken, to which the longitude made during the interval, reduced to time, being applied, by adding or subtracting it, according as the ship's place, when the distances were observed, is east or west of its place when the altitudes for time were taken; the result will be the time at the ship corresponding to the place where the distances were observed: this compared with the time at Greenwich, will shew the Ship's longitude at the time of taking the distances.

Suppose, for instance, that in the fourth Example, when altitudes of the Sun were taken, about 4h. 40m. P. M. Ship time, the mean of the times shewn by a Chronometer, gaining 12 seconds per day, was 2h. 11m. 46s.; and the time by the same Chronometer when the distances were observed, 7h. 4m. 39s.; the Ship having between the observations made 48 miles of longitude to the Eastward; we may proceed as follows to find the time at Ship when the distances were taken, and thence the longitude at that time.

	h.	m.	s.	°	′	″
Time by Chronometer when the Sun's altitudes were observed	2	11	46			
Time by Chronometer when the distances were observed .	7	4	39			
Interval of time by Chronometer	4	52	53			
Proportional part of rate or daily gain of Chronometer during the above interval	—	—	2			
Interval corrected for rate of Chronometer . .	4	52	51			
App. time at Ship when Sun's altitudes were observed .	4	47	49			
Time at the above meridian when the distances were observed	9	40	40			
Change of Longitude (in time) during the interval 48′ E.	+	3	12			
Time at the Ship corresponding to the place where the distances were observed	9	43	52			
Time at Greenwich when the distances were observed .	7	29	2			
Long. of Ship when the distances were observed .	2	14	50	=33	42	30 E.

In the preceding Examples we have supposed altitudes to be taken at the same time with the distances; but circumstances may arise, such as an undefined horizon or want of assistants, which may prevent the altitudes of one or both the objects being observed: in these cases, it will be necessary to compute the altitudes corresponding to the distances.

For this purpose, take a set of altitudes of the Sun or a Star, when at a proper distance from the meridian, either before or after the distances are observed, noting the times by a Chronometer or steady going Watch, from which compute the apparent time at Ship; note also the times by the same Chronometer or Watch, when the distances were observed; then by means of the elapsed time, and the change of longitude during that interval, find the apparent time at the place where the distances were observed, as explained above; corresponding to which compute the altitudes by the following

RULES. 1. Find the least meridian distance of the given object, which, if it be the Sun, is the apparent time from the nearest noon; but if the object be the Moon or a Star, then add the Sun's right ascension to the apparent time; their sum (deducting 24 hours if it exceed that time) will be the right ascension of the meridian; the difference between which and the right ascension of the object, in time, will be its meridian distance; but should the remainder exceed 12 hours, subtract it from 24 hours to give the least meridian distance.

2. Add together the log. rising of the meridian distance (XXIX.), the log. co. sine of the latitude (XXV.), and the log. co. sine of the declination.

3. Find the natural number corresponding to the sum of these three logarithms (XXIV.), rejecting the tens of the index, and subtract it from the natural sine (XXVI.) of the sum of the co. latitude and declination, when they are of the same name, or their difference when of contrary names; the result will be the natural sine of the true altitude.

4. If the object be the Sun or a Star, the refraction (IV.) added to the true altitude, will give the apparent altitude; but if the Moon's apparent altitude be required, the correction taken from Table XXX., with the true altitude and horizontal parallax, is to be subtracted from the true altitude.

NOTE. The right ascension and declination of the Sun and Moon, and the Moon's horizontal parallax, are to be taken from the Nautical Almanac, and reduced to the time of observation. The right ascension and declination of a Star are to be taken from Table XIV.

Here follow two Examples, in which the apparent altitudes are found by the above rules.

EXAMPLE V.

March 28, 1830, in latitude 15° 10′ N. and longitude by account 62° 36′ E., about 20h. 10m. apparent time at Ship, the observed altitude of the Sun's lower limb was 31° 47′ 10″; a Chronometer, whose daily rate was 16 seconds losing, at the same time shewing 4h. 2m. 46s.; the height of the eye above the Sea being 18 feet, and the error of the Sextant + 2′ 30″.

On the same morning, when the above Chronometer shewed 6h. 31m. 58s., the distance between the Sun and Moon was observed to be 64° 49′ 10″, the Ship having since the first observation made 12 miles of latitude to the South, and 36 miles of longitude to the West, the height of the eye and the Index Error as before: required the longitude of the Ship at the time the distance was observed.

	° ′ ″		° ′ ″
Obs. alt. Sun's lower limb -	31 47 10	Sun's Dec. March 29, by N. A.	3 17 50 N.
Index Error - - - - - - -	+ 2 30	Corr. for long. 62° 36′ E. -	— 4 4
Corr. (Table IX.) + 10′.5 =	+ 10 30	Corr. for time 3h. 50m. bef. noon	— 3 41
True alt. Sun's center - - -	32 0 10	Sun's reduced declination -	3 10 5
			90
	h. m. s.		
T. by Chron. when ☉'s alt. was obs.	4 2 46	Polar distance - - - - - -	86 49 55
Do. when dist. was obs.	6 31 58		
Interval between the observations	2 29 12		

	° ′		
Sun's true altitude - -	32 00		
Sun's polar distance -	86 50	Co. secant -	0.00066
Ship's latitude - - -	15 10	Secant - -	0.01540
Sum - - - - - - -	134 00		
Half sum - - - - -	67 00	Co. sine - -	9.59188
Remainder - - - - -	35 00	Sine - - -	9.75859
		Const. Log. -	5.30103
	h. m. s.		
Time from noon - - - -	3 50 39	Rising - -	4.66756
	24		
App. time at place of observing Sun's altitude - -	20 9 21		
Interval between observations	2 29 12		
	22 38 33		
Pro. part of rate during interval	+ 2		
Change of long. 36′ W. = -	— 2 24		
App. time at place of observing distance, March 28	22 36 11		
	24		
Ditto before noon, March 29	1 23 49		

To find the Sun's Apparent Altitude.

	° ′		° ′ ″
Lat. when Sun's alt. was observed	15 10 N.	Long. by acc. when ☉'s alt. was obs.	62 36 E.
Lat. made during interval - -	— 12 S.	Long. made during interval -	— 36 W.
Lat. when distance was observed	14 58 N.	Long. by acc. when dist. was obs.	62 0 E.
	h. m. s.		
Time at Ship when dist. was obs.	22 36 11	Sun's declin. March 29, by N. A.	3 17 50 N.
Long. in time (Table XIX.) =	4 8 0 E.	Corr. for Greenwich time, 5h. 32m. before noon	— 5 22
Time at Greenwich - - -	18 28 11		
		Sun's reduced declination -	3 12 28 N.

	h. m. s.				
Time from noon - -	1 23 49			Log. rising	3.82044
Latitude - - - - -	14° 58′ N.			Co. sine -	9.98501
Declination - - - -	3 12½ N.			Co. sine -	9.99932
Co. latitude - - -	75 2				
		Nat. Number	6379	Log. - -	3.80477
Meridian altitude - -	78 14½	Nat. sine -	97902		
Sun's true altitude -	66 14	Nat. sine -	91523		
Refraction - - - - -	— 0				
Sun's app. altitude -	66 14				

To find the Moon's Apparent Altitude.

	° ′		° ′
Moon's R. A. at midn. March 28 -	67 52	Moon's Dec. at midn. March 28	16 39 N.
Ditto noon, March 29 -	75 9	Ditto noon, March 29	17 28 N.
Variation in 12 hours - - - -	7 17	Variation in 12 hours - - -	49
12h. : 7° 17′ :: 6h. 28m. :	+ 3° 55½′	12h. : 49′ :: 6h. 28m. :	+ 26′
Moon's R. A. at midn. March 28 -	67 52	Moon's Dec. at midn. March 28	16 39 N.
Ditto at Greenwich time -	71 47½ = 4h. 47m. 10s.	Ditto at Greenwich time	17 5 N.
		Moon's red. hor. parallax	58′ 52″

	h. m. s.		h. m. s.
Apparent time -	22 36 11		
Sun's R. Ascen. -	0 29 41		
R. A. of Merid. -	23 5 52	Sun's Right Ascen. March 29, by N. A. -	0 30 31
Moon's R. Ascen. -	4 47 10	Corr. for Greenwich time 5h. 32m. bef. n.	— 50
Moon's Mer. Distance	18 18 42 24	Sun's reduced Right Ascension - - -	0 29 41

Moon's least Mer. Dist.	5 41 18			Log. rising	4.96307
Latitude - - - -	14° 58′ N.			Co. sine -	9.98501
Moon's Declination	17 5 N.			Co. sine -	9.98040
Co. latitude - - -	75 2	Nat. number	84816	Log. - -	4.92848
	92 7 180 0				
Moon's Mer. Altitude	87 53	Nat. sine -	99932		
Moon's true Altitude	8 42	Nat. sine -	15116		
Moon's Corr. (XXX.)	— 52				
Moon's app. altitude	7 50				

To find the True Distance and thence the Longitude.

	°	′	″				
Obs. Dist. by Sextant	64	49	10				
Index Error - - -	+	2	30				
Corr. obs. distance -	64	51	40				
Sun's semidiameter	+	16	2				
Moon's semidiameter	+	16	3				
Moon's augmentation	+		2				
Apparent distance -	65	23	47				
Corr. for refraction	+	6	0				
Corrected distance -	65	29	47	Sine - - - - -	9.9590	Tangent	0.3413
Sun's app. altitude -	66	14		Co. secant - - -	0.0385		
Moon's app. altitude	7	50		Co. secant - - -			0.8655
Moon's hor. parallax		58	52	Pro. Log. - - -	0.4854		0.4854
First arch - - -		59	13	Pro. Log. - - -	0.4829		
Second arch - -		3	39			Pro. Log.	1.6922
Corr. for parallax -	—	55	34				
Corrected distance	65	29	47				
	64	34	13				
Third correction -		+	1				
True distance - -	64	34	14	First diff.	0° 13′ 53″	Pro. Log.	1.1128
Distance at 18 hours	64	20	21	Second diff.	1° 37′ 29″	Pro. Log.	0.2663
Distance at 21 hours	65	57	50				

	h.	m.	s.		
Proportional part - - -	0	25	38	Pro. Log.	0.8465
Time of first distance -	18	0	0		
App. time at Greenwich	18	25	38		
App. time at Ship when distance was observed	22	36	11		
Longitude of Ship when distance was observed	4	10	33	= 62° 38′ 15″ East.	

EXAMPLE VI

July 2, 1830, about 11h. 36m. P. M. the Ship being in latitude 46° 54′ N. and longitude by account 23° 36′ W. the distance of the Moon's remote limb from the Star α Aquilæ was observed to be 57° 53′ 48″; and 16m. 49s. after, as measured by a good watch, (the Ship being nearly in the same place), the observed altitude of the Star Algenib was 15° 58′, east of the meridian; the height of the eye being 24 feet, and the error of the Sextant — 1′ 45″: required the longitude of the Ship.

To find the Apparent Time when the Star Algenib was observed.

	° ′ ″
Star's observed altitude - -	15 58 00
Index Error - - - - - - -	— 1 45
	15 56 15
Dip of hor. — 4′ 42″ Refraction — 3 17	— 7 59
Star's true altitude - - -	15 48 16
	h. m. s.
Sun's Right Ascen. July 2 -	6 43 37
Corr. for long. 23° 36′ W. -	+ 16
Corr. for time, 11h. 53m. -	+ 2 2
Sun's reduced Right Ascen. -	6 45 53

	h. m. s.
Star's Right Ascen. 1820 -	0 3 59
Ann. Var. + 3s.08 × 10½ =	+ 32
Star's R. A. July 1830 - -	0 4 31
	° ′ ″
Star's Declination, 1820 -	14 11 0 N.
Ann. Var. + 20″.20 × 10½ =	+ 3 32
Star's Declination, July 1830	14 14 32
	90
Star's Polar Distance - -	75 45 28

	° ′ ″		
Star's true altitude - -	15 48 16		
Polar distance - - -	75 45 28	Co. secant -	0.01356
Latitude - - - - -	46 54	Secant - -	0.16541
Sum - - - - - - - -	138 27 44		
Half sum - - - - -	69 13 52	Co. sine - -	9.54969
Remainder - - - - -	53 25 36	Sine - - -	9.90476
		Const. Log. -	5.30103
	h. m. s.		
Star's Distance from Meridian	5 27 47 E.	Rising - -	4.93445
Star's Right Ascen. + 24h. -	24 4 31		
Right Ascen. of Meridian -	18 36 44		
Sun's reduced Right Ascen.	6 45 55		
App. time when the Star Algenib was observed -	11 50 49		
Interval per Watch - - -	— 16 49		
App. time when the distance was observed - - -	11 34 0		

To find the Apparent Altitude of the Star α Aquilæ.

	h. m. s.
Time when Dist. was observed	11 34 0
Long. in time (23° 36′ W.) -	1 34 24
Greenwich time - - - - -	13 8 24
	h. m. s.
Sun's Right Ascen. July 3 -	6 47 44
Corr. for 10h. 52m. bef. noon	— 1 52
Sun's reduced R. Ascen. -	6 45 52
Apparent time - - - -	11 34 0
R. Ascen. of Meridian -	18 19 52
Star's Right Ascension -	19 42 31

	h. m. s.
Star's Right Ascension, 1820	19 42 0
Ann. Var. + 2s.93 × 10½ =	+ 31
Star's Right Ascen. July 1830	19 42 31
	° ′ ″
Star's Declination, 1820 -	8 24 5 N.
Ann. Var. + 9″.06 × 10½ =	+ 1 35
Star's Declin. July 1830 -	8 25 40 N.

Star's Meridian Distance -	1 22 39		Rising -	3.80838
Latitude - - - - -	46° 54′ N.		Co. sine -	9.83460
Star's Declination - -	8 26 N.		Co. sine -	9.99528
Co. latitude - - - -	43 6			
		Nat. Number 4348	Log. - -	3.63826
Star's Meridian altitude	51 32 -	Nat. sine - 78297		
Star's true altitude - -	47 41 -	Nat. sine - 73949		
Refraction - - - - -	+ 1			
Star's app. altitude - -	47 42			

To find the Moon's Apparent Altitude.

	° ′		° ′
Moon's R. A. at midn. July 2	243 3	Moon's Dec. at midn. July 2	16 3 S.
Ditto noon, July 3	249 24	Ditto noon, July 3	17 0 S.
Variation in 12 hours	6 21	Variation in 12 hours	0 57
12h. : 6° 21′ : : 1h. 8m. :	+ 36′	12h. : 57′ : : 1h. 8m. :	+ 5′
Moon's R. A. at midn. July 2	243 3	Moon's Dec. at midn. July 2	16 3 S.
Ditto at Greenwich time	243 39 = 16h. 14m. 36s.	Ditto at Greenwich time	16 8 S.

Moon's hor. parallax 55′ 3″

	h. m. s.		h. m. s.
Apparent time	11 34 0		
Sun's R. Ascen.	6 45 52	Sun's Right Ascen. July 3, by N. A.	6 47 44
		Corr. for 10h. 52m. before noon	— 1 52
R. A. of Merid.	18 19 52		
Moon's R. Ascen.	16 14 36	Sun's reduced Right Ascension	6 45 52

Moon's Mer. Distance	2 5 16			Rising	4.16343
Latitude	46° 54′N.			Co. sine	9.83460
Moon's Declination	16 8 S.			Co. sine	9.98255
Co. latitude	43 6				
		Nat. number	9563	Log.	3.98058
Moon's Mer. Altitude	26 58	Nat. sine	45347		
Moon's true Altitude	20 58	Nat. sine	35784		
Moon's Corr. (XXX.)	— 49				
Moon's app. altitude	20 9				

To find the True Distance and thence the Longitude.

	° ′ ″				
Obs. Dist. by Sextant	57 53 48				
Index Error	— 1 45				
Corr. obs. distance	57 52 3				
Moon's semidiameter	— 15 0				
Moon's augmentation	— 6				
Apparent distance	57 36 57				
Corr. for refraction	+ 1 46				
Corrected distance	57 38 43	Sine	9.9268	Tangent	0.1983
Star's app. altitude	47 42	Co. secant	0.1310		
Moon's app. altitude	20 9	Co. secant			0.4628
Moon's hor. parallax	55 3	Pro. Log.	0.5145		0.5145
First arch	48 11	Pro. Log.	0.5723		
Second arch	12 1			Pro. Log.	1.1756
Corr. for parallax	— 36 10				
Corrected distance	57 38 43				
	57 2 33				
Third correction	+ 8				
True distance	57 2 41		° ′ ″		
Distance at 12 hours	57 31 0	First diff.	0 28 19	Pro. Log.	8032
Distance at 15 hours	56 12 17	Second diff.	1 18 43	Pro. Log.	3592

	h. m. s.		
Proportional part	1 4 45	Pro. Log.	4440
Time of first distance	12 0 0		
App. time at Greenwich	13 4 45		
Time at place of observed distance	11 34 0		
Long. at place of observed distance	1 30 45 = 22° 41′ 15″ West.		

EXAMPLE VII.

January 19, 1830, at about 0h. 46m. P. M. Ship time, in latitude 40° 16 S. and longitude by account 92° E. the following observations were taken of the Sun and Moon, with the corresponding times by a Chronometer.*

On the same day at 3h. 19m. P. M. Ship time, when the same Chronometer shewed 9h. 34m. 40s., the altitude of the Sun's lower limb was 43° 11′ 30″, the Ship having, since the first observations were made, run 30 miles of longitude east, but remained in the same latitude. Required the true longitude of the Ship when the distances were observed.

The height of the eye was 16 feet, and the error of the Sextant 2′ 15″ to be subtracted.

	Times per Chron. h. m. s.		° ′ ″	
	6 54 42	Altitude of Sun's lower limb -	67 18 0	
	6 57 19	Altitude of Moon's upper limb	13 57 0	
Mean of Times. 7h. 3m. 30s.	7 1 14	Distance of nearest limbs -	67 4 30	Mean Distance. 67° 3′ 5″
	7 3 48	Distance of nearest limbs -	67 3 20	
	7 5 28	Distance of nearest limbs -	67 1 25	
	7 9 21	Altitude of Moon's upper limb	11 40 0	
	7 12 4	Altitude of Sun's lower limb -	65 53 0	

To reduce the Altitudes of the Sun and Moon to the time of the Mean Distance.

	h. m. s.		h. m. s.		° ′
Time of Sun's first alt.	6 54 42	Time of Sun's first alt.	6 54 42	Sun's first alt.	67 18
Time of Sun's last alt.	7 12 4	Mean of Times by Chro.	7 3 30	Sun's last alt.	65 53
Differences - - -	17 22		8 48		1 25

As	17m. 22s. - -	Pro. Log. (Arith. Comp.)	8.9844
Is to	8 48 - -	Pro. Log. - -	1.3108
So is	1° 25′ - -	Pro. Log. - -	0.3259
To decrease of Sun's altitude	° ′ ″ 0 43 4 - -	Pro. Log. - -	0.6211
Sun's first observed altitude	67 18 0		
Sun's altitude at mean of times	66 34 56		

	h. m. s.		h. m. s.		° ′
Time of Moon's first alt.	6 57 19	Time of Moon's first alt	6 57 19	Moon's first alt.	13 57
Time of Moon's last alt.	7 9 21	Mean of Times by Chro.	7 3 30	Moon's last alt.	11 40
Differences - - -	12 2		6 11		2 17

As	12m. 2s. - -	Pro. Log. (Arith Comp.)	8.8251
Is to	6 11 - -	Pro. Log - -	1.4640
So is	2° 17′ - -	Pro. Log. - -	0.1186
To decrease of Moon's altitude	° ′ ″ 1 10 24 - -	Pro. Log. - -	0.4077
Moon's first observed altitude	13 57 0		
Moon's alt. at mean of times	12 46 36		

Hence we obtain the following set of observations :

Mean of Times by Chron.	Dist. nearest l. of ☉ & ☽.	Alt. of ☉'s low. l.	Alt. of ☽'s up. l.
7h. 3m. 30s.	67° 3′ 5″	66° 34′ 56″	12° 46′ 36″

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* For the method of taking the altitudes and distances without assistants, see page 224 ;—see also explanation to Table XXXIV.

	h.	m.	
Time at Ship, Jan. 19	0	46	
Long. in time (XIX.)	6	8	E.
Reduced time, Jan. 18	18	38	

	°	′	″
Observed distance	67	3	5
Index Error - - -	—	2	15
	67	0	50
Sun's semidiameter	+	16	17
Moon's semidiameter	+	15	3
Moon's augmentation	+		4
Apparent distance -	67	32	14
Corr. for refraction	+	3	47

		′	″
☽'s red. hor. par.		55	14
		°	′
Obs. alt. ☉'s l. limb		66	35
☉'s semid. + 16′ 17″	}	+	12
Dip of hor. — 3 50			
☉'s app. altitude		66	47

		°	′
Obs. alt. ☽'s up. limb		12	47
☽'s semid. -- 15′ 7	}	—	19
Dip of hor. — 3 50			
☽'s app. altitude		12	28

Corrected distance -	67 36 1	- Sine - - - - -	9.9659	- Tangent	0.3849
Sun's app. altitude -	66 47	- Co. secant - - -	0.0367		
Moon's app. altitude	12 28	- Co. secant - - - - - - - - - - -			0.6658
Moon's hor. parallax	55 14	- Pro. Log. - - -	0.5131	- - - - -	0.5131
First arch - - -	54 54	- Pro. Log. - - -	0.5157		
Second arch - -	4 55	- - - - - - - - - - - - -		Pro. Log.	1.5638
Corr. for parallax -	49 59				
Corrected distance	67 36 1				
	66 46 2				
Third correction -	+ 1				

			° ′ ″		
True distance - -	66 46 3				
Distance at 18 hours	67 4 11	- - - First diff.	0 18 8	- - Pro. Log.	9968
Distance at 21 hours	65 39 42	- - - Second diff.	1 24 29	- - Pro. Log.	3285
			h. m. s.		
		Proportional part - - -	0 38 38	- - Pro. Log.	6683
		Time of first distance - -	18 0 0		
		Time at Greenwich - -	18 38 38 Jan. 18.		

	°	′	″
Obs. alt. Sun's lower limb	43	11	30
Index Error - - - - -	—	2	15
	43	9	15
Corr. Table IX. + 11′.4 =	+	11	24
Sun's true altitude - -	43	20	39

	°	′	″	
Sun's Declin. Jan. 19, N. A.	20	22	37	S.
Corr. for longitude 92° E.	+	3	2	
Corr. for time 3h. 19m. P. M.	—	1	36	
Sun's reduced declination	20	24	3	
	90			
Polar distance - -	69	35	57	

Sun's Polar distance -	69 35 57	- Co. secant -	0.02813
Ship's Latitude - - -	40 16	- Secant - -	0.11745
Sum - - - - - - - -	153 12 36		
Half sum - - - - - -	76 36 18	- Co. sine - -	9.36502
Remainder - - - - - -	33 15 39	- Sine - - -	9.73911
		Const. Log. -	5.30103
	h. m. s.		
App. time when Sun's altitude was observed	3 19 28	- Rising -	4.55074
Interval by Chronometer	2 31 10		
App. time when dist. was obs.	0 48 18 Jan. 19.		
Time at Greenwich when distance was observed	18 38 38 Jan. 18.		

	h.	m.	s.
Time by Chron. when the distance was taken -	7	3	30
Time by Chron. when the Sun's alt. was observed	9	34	40
Interval by Chronometer	2	31	10

		° ′	
Long. when ☉'s alt. was obs.	6 9 40 =	92 25	East.
Long. made during interval - -		— 30	East.
Long. of Ship when dist. was observed		91 55	East.

QUESTIONS FOR EXERCISE.

I. June 12, 1830, in latitude 29° 7′ N. and longitude by account 145° W, about 20h. 32m. (being June 13, at 8h. 32m. A. M. civil time), the distance between the Sun and Moon was observed to be 92° 40′ 15″; at the same time the altitude of the Moon's upper limb was 39° 25′, and the altitude of the Sun's lower limb 42° 48′; the height of the eye being 18 feet: required the true longitude of the Ship.

Answer. The true distance 92° 31′ 56″; apparent time at Greenwich 30h. 8m. 25s. after noon of June 12; apparent time at Ship 20h. 30m. 25s., and longitude of the Ship 144° 30′ 00″ West.

II. January 10, 1830, in latitude 8° 25′ S. and longitude by account 95° West, about midnight, the distance of the Moon's remote limb from the Star Aldebaran, was observed to be 68° 41′ 25″, the altitude of the Moon's lower limb being 54° 26′, the altitude of the Star (westward of the meridian) 37° 25′ and the height of the eye 14 feet: required the true longitude of the Ship.

Answer. The true distance 68° 9′ 6″; the apparent time at Greenwich 18h. 24m. 9s.; the apparent time at Ship 12h. 5m. 17s., and the longitude of the Ship 94° 43′ 00″ West.

III. August 25, 1830, in latitude 37° 30½′ N. and longitude by account 32° East, at 19h. 48m. 36s. by watch (being August 26, at 7h. 48m. 36s. A. M. civil time), the altitude of the Sun's lower limb was 27° 47′ 30″: and on August 26, at 1h. 48m. 45s. by the same watch, the distance between the Sun and Moon was observed to be 89° 5′ 54″; the altitude of the Sun's lower limb being 54° 14′, the altitude of the Moon's upper limb 12° 51′, and the height of the eye 18 feet: required the true longitude of the Ship at the time the Sun's altitude was taken to find the Error of the watch.

Answer. The apparent time at the meridian of the Ship when the Sun's altitude was observed 19h. 48m. 53s., consequently the watch was 0m. 17s. too slow; the true distance 88° 56′ 2″, the corresponding time at Greenwich 23h. 44m. 12s. on August 25; the time at Ship 25h. 49m. 2s past noon, August 25, and hence the longitude of the Ship 31° 12′ 30″ East.

IV. July 9, 1830, in latitude 16° 35′ S. and longitude by account 165° West, at 16h. 24m. 45s. by watch (that is, July 10, at 4h. 24m. 45s. A. M. civil time), the distance of the Moon's nearest limb from the Star α Arietis was 50° 50′ 38″, the altitude of the Star 39° 36′, and the altitude of the Moon's upper limb 75° 25′: and at 20h. 14m. 36s. (being 8h. 14m. 36s. A. M. civil time) by the same watch, the altitude of the Sun's lower limb was 22° 49′ 30″; the Ship being then in latitude 16° 8′ S. and the height of the eye at each observation 12 feet: required the true longitude of the Ship at the time of the last observation.

Answer. The true distance 51° 5′ 45″; apparent time at Greenwich when the distance was observed 27h. 26m. 44s. past noon, July 9; apparent time at Ship when the Sun's altitude was observed 20h. 15m. 36s., consequently the watch was 1m. 0s. too slow; apparent time at Ship when the distance was observed 16h. 25m. 45s., and longitude of the Ship when the Sun's altitude was taken for finding the Error of the watch, 165° 14′ 45″ West.

V. October 4, 1830, in latitude 33° 45′ N. and longitude by account 72° 35′ W., about 5h. P. M. the altitude of the Sun's lower limb was observed to be 9° 17′ 10″, when a Chronometer, whose daily loss was $12^s.5$, shewed 9h. 52m. 43s.: and about 3h. 50m. afterwards, when the same Chronometer shewed 1h. 41m. 54s., the observed distance of the Moon's remote limb from the Star α Pegasi or Marcab was 63° 48′ 20″, the Ship having run between the observations S.W. by S. (true) 28 miles: required the true Longitude when the distance was taken, the height of the eye being 18 feet, and the Error of the Sextant + 2′ 15″.

Answer. Apparent time at Ship when the Sun's altitude was observed 5h. 2m. 15s.; apparent time at the place where the distance was taken 8h. 50m. 12s.; latitude by account when the distance was observed 33° 22′ N. and the longitude by account 72° 54′ W.; the Star's apparent altitude being 62° 57′; the Moon's apparent altitude 9° 33′, and the true distance 62° 43′ 28″; the apparent time at Greenwich 13h. 39m. 22s. and, consequently, the longitude of the Ship at the place where the distance was observed 72° 17′ 15″ West.

VI. October 26, 1830, in latitude 52° 26′ S. and longitude by account 133° 45′ E. at about 5h. 20m. P. M. the altitude of the Sun's lower limb was 15° 50′ 45″; and 7m. 36s. after the Sun's altitude was observed, the distance of the Sun and Moon's nearest limbs, (measured by the same Sextant) was 107° 8′ 45″; the Index Error of the instrument being 1′ 30″ to subtract, and the height of the eye 24 feet: required the true longitude of the Ship.

Answer. The apparent time at Ship when the Sun's altitude was observed 5h. 19m. 6s. and when the distance was taken 5h. 26m. 42s. past noon October 26; or 29h. 26m. 42s. October 25; the Sun's apparent altitude 14° 52′; the Moon's apparent altitude 43° 35′; and the true distance 107° 14′ 35″; the apparent time at Greenwich 20h. 31m 28s. October 25; and consequently the true longitude of the Ship 133° 48′ 30″ East.

TO FIND THE LONGITUDE BY CHRONOMETERS OR TIME-KEEPERS.

It has already been observed, that if a watch could be made to shew always precisely the time under any given meridian, the longitude of a place might be easily computed by comparing the time shewn by the watch with that at the given place; but it is hardly to be expected that such a complicated machine can perform so accurately as never to deviate from the time at the meridian to which it is set; nor indeed is this absolutely necessary; for if its error at the given meridian be known on a certain day, and also its rate, or daily gain or loss, in 24 hours of mean time, we can thence deduce the time at that meridian as well as if the hands of the watch actually pointed it out; provided that it goes uniformly, which is all that is essential in the motion of a time-keeper. In order, therefore, to obtain these particulars, it is usual for the maker, or person into whose care the machine is intrusted, to examine its error every day, by comparing it with a well-regulated astronomical clock: these errors being then set down in a book kept for the purpose, the daily differences shew its rate, and the regularity of its motion. If the errors or daily differences continue the same, the timekeeper is said to have no rate, and is keeping mean time exactly: should the time-keeper be too fast, and the error increasing, it is gaining on mean time; but if the error be decreasing, it is then losing: on the contrary, when the time-keeper is too slow, and the error increasing, it is losing on mean time, but if the error be decreasing, it is gaining. The rate and error of a time-keeper may likewise be ascertained by altitudes of the Sun, as will be shewn hereafter. For instance, suppose on a certain day a time-keeper was found, by altitudes of the Sun, to be 5h. 30m. 10s. too fast for mean time at the meridian of Madras; and that by observations taken ten days afterwards, it was 5h. 30m. 40s. too fast; I thence find that it has gained 30 seconds in 10 days, and conclude that its daily gain is 3 seconds. Again, suppose on August 13th, a Chronometer was 12m. 10s. too fast for mean time at Greenwich; but by observations taken on August 28th, it was found to be 10m. 40s. too fast for mean time at the same place; here it appears that the Chronometer has lost 1m. 30s or 90s. in 15 days, and consequently is losing 6 seconds daily. Observations of this kind should be repeated and compared together as often as convenient, in order to find the rate the watch has gone at between every two such observations, by which the regularity of its going will be proved. Having by these means established its rate and error at the meridian of the place of observation, the longitude of a ship on her voyage may be found by the following

RULES. 1. Take several altitudes of the Sun or a Star, when it bears as nearly East or West as possible, but always at least three points from the meridian, and note the times by a Chronometer when they are observed, of which take the means.

2. To the mean of the times apply the *original error*, that is, add what the Chronometer was too slow, or subtract what it was too fast, for mean time on a given day, at the meridian of the place where the rate was ascertained: the sum or remainder will be the mean time by Chronometer, corrected for the original error.

3. Multiply the *daily rate* by the number of days and parts of a day that have elapsed since the original error was determined; the product, which may be called the *accumulated rate*, added to the above sum or remainder, if the time-keeper be losing, or subtracted from it if gaining, the result will give the mean time at the meridian where the rate and original error were ascertained. Should the meridian not be that of Greenwich, then add the longitude of the place in time, if it be west, or subtract it if east, and the sum or remainder will be the mean time at Greenwich by Chronometer.

4. With the latitude of the place of observation, the true altitude of the Sun or Star, and the reduced declination, find the apparent time as directed by the rules in page 226 or 230; to which apply the equation of time (taken from page II of the month in the Nautical Almanac, and reduced to Greenwich time by Table XXXVII.) by addition or subtraction, as denoted in the column from whence it is taken in the Nautical Almanac; hence will be found the mean time at the Ship or place of observation, the difference between which, and the mean time at Greenwich, obtained by the Chronometer, will give the longitude; east, if the time at the Ship be greater, or west if it be less, than the time at Greenwich.

NOTE. As the Sun's declination, right ascension, and other elements given in the Nautical Almanac, are calculated to apparent time, it will be more accurate, especially when the equation of time is considerable, to apply the reduced equation of time, with a contrary sign, to the mean time at Greenwich, by the Chronometer, which will give the apparent time at Greenwich, to which time the Sun's declination, &c. should be reduced: then the difference between the apparent time at Ship and apparent time at Greenwich will give the longitude.

EXAMPLE I.

May 19, 1830, P. M., in latitude 42° 15′ N. the following altitudes of the Sun's lower limb were observed, with the corresponding times by a Chronometer (being P. M. at Greenwich), whose daily gain had been settled at noon, March 17, at 7.8s., when it was 1m. 18s. too fast for mean time at Greenwich: the instrument having no index error, and the height of the eye being 26 feet above the sea: required the longitude of the ship.

Times by Chr. h. m. s.	Altitudes. ° ′	
6 58 40	44 7	
6 59 36	43 57	
7 0 51	43 44	
7 2 12	43 33	
7 3 21	43 24	
5) 35 4 40	218 45	
7 0 56	43 45	
— 1 18		Original error
6 59 38		
— 8 14		Accumulated rate.
6 51 24		Mean time at Greenw. May 19, P. M.

	° ′ ″
Obs. alt. ☉'s low. limb	43 45 0
Semidiam + 15′ 50″ Dip of hor. — 4 52	+ 10 58
Sun's apparent alitude	43 55 58
Refraction .	— 59
Sun's true altitude .	43 54 59

	s.
Daily gain .	7.8
Days from March 17 to May 19	63
	234
	468
	60) 491.4
Gain in 63 days	8m. 11.4s.
Ditto in 7 hours +	2.3
Accumulated rate	8m. 13.7s.

	° ′ ″
Sun's declination by N. A. May 19,	19 43 6 N.
Corr. for Greenwich time, 6h. 51m. afternoon .	+ 3 44
Sun's reduced declination .	19 46 50 N.
	90
Sun's polar distance .	70 13 10

	° ′		
Sun's true altitude .	43 55		
Polar distance .	70 13	Co. secant	0.02642
Latitude . .	42 15	Secant	0.13064
Sum . .	156 23		
Half Sum . .	78 11½	Co. sine	9.31099
Remainder . .	34 16½	Sine	9.75064
		Const. Log.	5.30103
	h. m. s.		
Apparent time at Ship .	3 12 1	Log rising	4.51972
Equation .	— 3 50		
Mean time at Ship .	3 8 11		
Mean time at Greenwich .	6 51 24		
Longitude in time .	3 43 13 = 55° 48′ 15″ West.		

EXAMPLE II.

April 22, 1830, a Chronometer was 2h. 31m. 45s. too fast for mean time at Greenwich, and was gaining 2.1s. per day.

June 24, 1830 (June 25, A. M. civil time), in latitude 10° 3′ S. the following altitudes of the Sun's lower limb were observed, with the corresponding times by the same Chronometer (being A. M. at Greenwich), the height of the eye above the sea being 20 feet, and the error of the quadrant 1′ 30″ to add: required the longitude of the Ship.

Times by Chr. h. m. s.	Altitudes. ° ′	
23 28 35	10 7	
29 20	10 17	
30 48	10 32	
32 6	10 54	
33 24	11 14	
5) 154 13	53 4	
23 30 51	10 36 48	
2 31 45		Original error.
20 59 6		
— 2 14		Accumulated rate.
20 56 52		Mean time at Greenw. June 24.
24		
3 3 8		Ditto before noon, June 25.

	° ′ ″
Obs. alt. ☉'s low. limb	10 36 48
Index Error .	+ 1 30
	10 38 18
Semidiam + 15′ 46″ Dip of hor. — 4 17	+ 11 29
Sun's apparent altitude	10 49 47
Refraction .	— 4 51
Sun's true altitude .	10 44 56

	s.
Daily gain .	2.1
Days from April 22 to June 25	64
	84
	126
	60) 134.4
Gain since Apr. 22, 2m. 14s.	

	° ′ ″
Sun's declination, June 25, by N.A.	23 25 0 N.
Corr. for time before noon, 3h. 3m.	0 0
Sun's reduced declination	23 25 0
	90
Sun's polar distance .	113 25 0

	° ′		
True altitude . .	10 45		
Polar distance .	113 25	. Co. secant .	0.03733
Latitude . .	10 3	. Secant .	0.00672
Sum . .	134 13		
Half Sum . .	67 6½	. Co. sine .	9.58994
Remainder . .	56 21½	. Sine . .	9.92039
		Const. Log. .	5.30103
	h. m. s.		
Time from noon .	4 54 12	. Log. rising .	4.85541
	24		
Apparent time at Ship .	19 5 48		
Equation of time .	+ 2 6		
Mean time at Ship .	19 7 54		
Mean time at Greenwich .	20 56 52		
Longitude in time .	1 48 58 = 27° 14′ 30″ West.		

EXAMPLE III.

October 18, 1830, P M., in latitude 15° 46′ N. the observed altitude of the Sun's lower limb was 12° 40′ when a Chronometer shewed 11h. 12m. 42s. (being A. M. at Greenwich), whose error on August 12 was 5m. 26s. too slow at noon for Greenwich mean time, and was gaining 12.5s. per day: the index error of the instrument being + 2′ 30″, and height of the eye 16 feet: required the true longitude of the Ship.

	h. m. s.
Time by Chron.	23 12 42
Original error .	+ 5 26
	23 18 8
Accumulated rate	— 13 58
Mean time at Greenw. Oct. 17	23 4 10
	24
Ditto bef. noon, Oct. 18	0 55 50

	° ′ ″
Obs. alt. ☉'s low. l.	12 40 0
Index error .	+ 2 30
	12 42 30
Semidiam. 16′ 6″ Dip of hor. 3 50	+ 12 16
Sun's app. altitude	12 54 46
Refraction .	— 4 6
Sun's true altitude	12 50 40

	s.
Daily gain .	12.5
Days from Aug. 12 to Oct. 18 .	67
	875
	750
	60) 837.5

Accumulated rate 13m. 57.5s.

	° ′ ″
Sun's declination, Oct. 18 -	9 32 21 S.
Corr. for 56m. before noon -	— 54
Sun's reduced declination -	9 31 27
	90
Sun's polar distance -	99 31 27

	° ′		
Sun's true altitude -	12 50½		
Polar distance -	99 31½	Co. secant -	0.00603
Latitude -	15 46	Secant -	0.01666
Sum - -	128 8		
Half sum - -	64 4	Co. sine - -	9.64080
Remainder - -	51 13½	Sine - -	9.89188
		Const. Log. -	5.30103
	h. m. s.		
Apparent time at Ship -	4 54 35	Rising -	4.85640
Equation of time -	— 14 41		
Mean time at Ship -	4 39 54 October 18.		
	24		
Ditto - - -	28 39 54 October 17.		
Mean time at Greenwich	23 4 10 October 17		
Longitude in time -	5 35 44 = 83° 56′ East.		

EXAMPLE IV.

April 25, 1830, A. M. (civil time), in latitude 27° 20′ S. the observed altitude of the Sun's upper limb was 38° 42′ 50″ when a time-keeper shewed 2h. 12m. 50s. (being P. M. at Greenwich), which at noon, April 2, was 1h. 10m. 15s. too fast for mean time at Greenwich, and was losing 4.3s. per day: the error of the quadrant being + 2′ 40″, and the height of the eye 30 feet: required the true longitude of the Ship.

	h.	m.	s.
Time by Chron.	2	12	50
Original error .	1	10	15
	1	2	35
Accumulated rate	+	1	39
Mean time at Greenw. Apr. 25	1	4	14
	24		
Ditto, April 24,	25	4	14

	°	′	″
Obs. alt. ☉'s up. l.	38	42	50
Index error .	+	2	40
	38	45	30
Semidiam. 15′ 55″ Dip of hor. 5 15	—	21	10
	38	24	20
Refraction .	—	1	11
True altitude .	38	23	9

	s.
Daily loss .	4.3
Days from April 2 to April 25 .	23
	129
	86
	60) 98.9
Loss in 23 days	1m. 38.9s.
Ditto in 1h. 3m.	.2
Accumulated rate	1m. 39.1s.

		°	′	″
Sun's declination, April 25	-	13	6	52 N.
Corr. for 1h. 4m. after noon	-	+		50
Sun's reduced declination	-	13	7	42
		90		
Sun's polar distance	-	103	7	42

		°	′			
Sun's true altitude	-	38	23			
Polar distance	-	103	8	-	Co. secant -	0.01151
Latitude	-	27	20	-	Secant -	0.05142
Sum	- -	168	51			
Half sum	- -	84	25½	-	Co. sine - -	8.98744
Remainder	- -	46	2½	-	Sine - -	9.85724
					Const. Log. -	5.30103

		h.	m.	s.			
Time from noon	-	2	12	9	-	Rising -	4.20864
		24					
App. time at Ship	-	21	47	51			
Equation of time	-	—	2	5			
Mean time at Ship	-	21	45	46 April 24.			
Mean time at Greenwich		25	4	14 April 24.			
Longitude in time	-	3	18	28 = 49° 37′ 0″ West.			

EXAMPLE V.

January 27, 1830, in latitude 6° 58′ N. the following altitudes of the Sun's lower limb were observed (the eye being elevated 18 feet) corresponding to the times shewn by a Chronometer, originally set to Greenwich time, where it was A. M. at the time of observation, whose error and rate were settled at Bombay, in longitude 72° 54′ 24″ E. on January 16; having on that day, at noon, been 5h. 17m. 42s. too slow, and losing 5.5s. daily: required the true longitude of the Ship.

Times by Chron. h. m. s.	Altitudes. ° ′
23 4 26	18 42
7 17	18 12
9 30	17 41
3) 21 13	54 35
23 7 4	18 11 40

	° ′ ″
Obs. alt. ☉'s low. limb	18 11 40
Semidiameter 16′ 16″ Dip of hor. 4 4	+ 12 12
Sun's app. altitude	18 23 52
Refraction	− 2 50
Sun's true altitude	18 21 2

	s.
Daily loss	5.5
Days from Jan. 16 to Jan. 27	11
	60) 60.5
Accumulated rate	1m. 0.5s.

	° ′ ″
Sun's declination, Jan. 27,	18 30 14S
Corr. for 0h. 39m. bef. noon	+ 22
Sun's reduced declination	18 30 36
	90
Sun's polar distance	108 30 36

h. m. s.	
23 7 4	
5 17 42	Original error.
28 24 46	
+ 1 1	Accumulated rate.
28 25 47	Mean time at Bombay, aft. n. Jan. 26.
4 51 38	Long. of Bombay E.
23 34 9	Mean time at Greenwich, Jan. 26.
− 13 6	Equation of time.*
23 21 3	App. time at Greenwich, Jan. 26.

	° ′		
True altitude	18 21		
Polar distance	108 30½	Co. secant	0.02306
Latitude	6 58	Secant	0.00322
Sum	133 49½		
Half sum	66 55	Co. sine	9.59336
Remainder	48 34	Sine	9.87490
		Const. Log.	5.30103
	h. m. s.		
Apparent time at Ship, Jan. 27	4 31 48	Rising	4.79557
	24		
Ditto after noon, Jan. 26	28 31 48		
App. time at Greenwich, Jan. 26	23 21 3		
Longitude in time	5 10 45 = 77° 41′ 15″ East.		

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* See Note in page 262.

EXAMPLE VI.

May 28, 1830, P. M., in latitude 0° 48′ N., the mean of several altitudes of the Star Antares, when eastward of the meridian, was 30° 42′ 30″, the height of the eye being 16 feet, and the mean of the times by a Chronometer 10h. 13m. 21s. P. M., which had been found, May 5, at St. Helena, in longitude 5° 43′ 30″ W., 0h. 54m. 32s. too fast at noon, and gaining daily 15.4s.: required the longitude of the Ship.

	h. m. s.
Time by Chron.	10 13 21
Original error	− 54 32
	9 18 49
Accum. rate	− 6 0
Mean time at St. Helena	9 12 49
Long. of ditto	+ 22 54W.
Mean time at Greenwich	9 35 43
Equa. of time	+ 3 5
App. time at Greenwich	9 38 48

	° ′ ″
Star's obs. alt. .	30 42 30
Dip of hor. .	− 3 50
Refraction .	− 1 35
Star's true alt. .	30 37 5
	h. m. s.
☉'s R. A. May 28	4 18 56
Corr. for 9h. 39m.	+ 1 37
Sun's red. R. A.	4 20 33
	h. m. s.
Star's R. A. 1820	16 18 22
An.V.+3s.66×10½=	+ 38
Star's red. R. A.	16 19 0

	s.
Daily gain .	15.4
Days from May 5 to May 28 .	23
	60) 354.2
Gain in 23 days .	5m. 54s.
Gain in 9 hours .	+ 6
Accumulated rate	6m. 0s.
	° ′ ″
Star's declin. 1820	26 1 16S
An.V.+8″.62×10½=	+ 1 31
Star's red. declin.	26 2 47
	90
Star's polar dist.	116 2 47

	° ′		
Star's true altitude - -	30 37		
Star's polar distance -	116 3	- Co. secant -	0.04653
Latitude - -	0 48	- Secant -	0.00004
Sum - -	147 28		
Half sum - -	73 44	- Co. sine -	9.44733
Remainder - -	43 7	- Sine -	9.83473
		Const. Log.	5.30103
	h. m. s.		
Star's distance from meridian -	3 39 57 E.	- Rising -	4.62966
Star's right ascension -	16 19 0		
Right ascension of meridian -	12 39 3		
Sun's right ascension -	4 20 33		
Apparent time at Ship -	8 18 30		
Apparent time at Greenwich -	9 38 48		
Longitude in time - -	1 20 18 = 20° 4′ 30″ West.		

In the last two examples, the errors of the Chronometers are given for the places where the rates were ascertained; but as it may be more convenient to have their errors on mean time at Greenwich, these may be obtained by applying the longitude in time, to the mean time at the place of observation (subtracting in East longitude and adding in West), the result will shew the mean time at Greenwich.

Suppose (Example V.) that by an observation taken at Bombay, January 16, 1830, the Chronometer shewed at noon, 18h. 42m. 18s. required its error on Greenwich mean time.

	h.	m.	s.	
Mean time at Bombay	24	0	0	**January 15.**
Longitude of Bombay	4	51	38	**E.**
Mean time at Greenwich	19	8	22	
Time by Chronometer	18	42	18	
Chronometer too slow for Greenwich mean time	0	26	4	

Then to find the mean time at Greenwich when the altitudes were taken on January 27th, we should proceed thus:

	h.	m.	s.
Mean of times by Chronometer	23	7	4
Original error (January 16)	+	26	4
	23	33	8
Accumulated rate	+	1	1
Mean time at Greenwich	23	34	9

In Example VI. suppose May 5, 1830, at St. Helena, the Chronometer shewed 0h. 54m. 32s. when it was mean noon at that place; required its error on Greenwich mean time.

	h.	m.	s.	
Mean time at St. Helena	0	0	0	
Longitude of St. Helena	0	22	54	**W.**
Mean time at Greenwich	0	22	54	
Mean time by Chronometer	0	54	32	
Chronometer too fast for Greenwich mean time	0	31	38	

Then to find Greenwich mean time when the observations were made, May 28th.

	h.	m.	s.
Mean time by Chronometer	10	13	21
Original error (May 5)	—	31	38
	9	41	43
Accumulated rate	—	6	0
Mean time at Greenwich	9	35	43

When several Chronometers are on board, the time shewn by one of them, with a corresponding set of altitudes, will serve to find the longitude by them all; for this purpose the observer is to compare one of the Chronometers with each of the others, immediately before the observations, and note their differences; these differences are to be applied to the mean of the times shewn by the above Chronometer, when the altitudes are taken, which will give the corresponding times by each Chronometer: to these apply their original errors and accumulated rates, and the result will be the several mean times at Greenwich, or other meridian to which the Chronometers are set; the differences between which and the mean time at Ship, deduced from the altitudes, will give the longitude according to each Chronometer.

It is the practice with many persons to use a good pocket watch, having a hand that points out seconds, instead of noting the times by one of the Chronometers. When this plan is adopted, the comparisons are to be made before the observations, as above directed, and the differences applied to the times shewn by the watch, when the altitudes are taken.

To ensure accuracy, it may be advisable to compare the watch with the Chronometers immediately after the observations are made, and if the differences be not the same, a proportional part of the change of differences should be applied to those shewn before the observation.

EXAMPLE VII.

November 15, 1829, a Chronometer, No. 156, was 5m. 27s. slow on mean time at Greenwich, and losing daily 6.4s.

January 24, 1830 (January 25th A. M. civil time), in latitude 26° 49½′ S. the following altitudes were observed, with the corresponding times by the above Chronometer, which had been previously compared with Nos. 284, 376, and 807: required the longitude by each Chronometer, also the longitude brought up to noon, the ship having made 10 miles of longitude west between the time of observation and noon; the height of the eye being 20 feet, and no index error to the sextant.

Times by Chron. No. 156.	h.	m.	s.
	17	17	16
		18	1
		18	47
3)		54	4
Means .	17	18	1
Original error	+	5	27
	17	23	28
Accum. rate	+	7	33
Mean time at Greenw.	17	31	1
	24		
Ditto before noon, 25th	6	28	59

Alt. ☉'s low. limb.	°	′	″
. .	24	24	15
. .		33	50
. .		40	30
		98	35
	24	32	52
Index error .		0	0
	24	32	52
Semid. 16′16″ Dip . 4 17	+	11	59
App. altitude	24	44	51
Refraction .	—	2	4
True altitude	24	42	47

	s.
Daily loss of Chron. No. 156	6.4
Days elapsed since Nov. 15	70
	60) 448.0
Loss in 70 days .	7m. 28.0s.
Ditto in 17h. 23m. .	+ 4.6
Accumulated rate .	7m. 32.6s.
	° ′
Sun's declination, Jan. 25	19 0 28 S.
Corr. for Greenw. time, 6h. 29m. before noon	+ 3 51
Sun's reduced declination	19 4 19
	90
Sun's polar distance	70 55 41

	° ′		
True altitude - -	24 43		
Polar distance - -	70 55½ -	Co. secant -	0.02453
Latitude - -	26 49½ -	Secant -	0.04945
Sum - -	122 28		
Half sum - -	61 14 -	Co. sine -	9.68237
Remainder - -	36 31 -	Sine -	9.77456
		Const. Log. -	5.30103
	h. m. s.		
Time from noon -	4 45 8 -	Rising -	4.83194
	24		
Apparent time at Ship -	19 14 52		
Equation of time -	+ 12 36		
Mean time at Ship -	19 27 28		
Mean time at Greenwich by Chronometer, No. 156	17 31 1		

Longitude in time by ditto - 1 56 27 = 29° 6′ 45″ East.
Longitude made to noon - — 10 0 West.

Longitude at noon - 28 56 45 East.

	No. 284.			No. 376.			No. 807.		
	h.	m.	s.	h.	m.	s.	h.	m.	s.
Chronometer, No. 156 - - -	17	12	41	17	13	26	17	14	35
Chronometers - - - - -	17	16	18	17	23	42	17	8	53
Differences - - - - - - -	+	3	37	+	10	16	—	5	42
Chronometer, No. 156, when altitudes were taken -	17	18	1	17	18	1	17	18	1
	17	21	38	17	28	17	17	12	19
Original Errors - - - - -	+	7	24	+	10	26	+	15	48
	17	29	2	17	38	43	17	28	7
Accumulated rates - - - -	+	2	11	—	7	28	+	3	2
Mean time at Greenwich by Chronometers - - - -	17	31	13	17	31	15	17	31	9
Mean time at Ship - - - -	19	27	28	19	27	28	19	27	28
Longitude in time - - - -	1	56	15	1	56	13	1	56	19
	°	′	″	°	′	″	°	′	″
Longitude of Ship - - - -	29	3	45	29	3	15	29	4	45 E.
Longitude made to noon - -	—	10	0	—	10	0	—	10	0 W.
Longitude at noon - - - -	28	53	45	28	53	15	28	54	45 E.

		° ′ ″
Longitude by No. 156	—	28 56 45
— — No. 284	—	28 53 45
— — No. 376	—	28 53 15
— — No. 807	—	28 54 45
		4) 218 30
Mean Longitude at noon	—	28 54 37 E.

To find the Rate of a Chronometer or Timekeeper.

When a Chronometer is received from the maker, or person to whose care it has been intrusted to regulate its going, a memorandum is always given with it, stating how much it is too fast or too slow for mean time at the meridian of the place, on a given day; and its daily rate of going, that is, its gain or loss in 24 hours of mean time, in seconds and tenths of a second; these particulars should be entered in a book kept for the purpose of carrying on the sum of the daily rates, or the total gain or loss of the Chronometer, to each day at noon; so that the accumulated rate may be readily known without the trouble of calculating its amount every day of observation.

Should the rate of a Chronometer continue always uniform, the longitude is to be found as shewn in the last problem; but as these instruments are liable to vary their rates, it is necessary to examine their going whenever opportunities present themselves; and this may easily be done when the ship is in harbour, or in the same place, two or three weeks, by taking a set of altitudes when the Sun is at a proper distance from the meridian; from which the mean time at the place of observation may be obtained; the difference between which, and the mean of the times pointed out by the Chronometer, will give what it is too fast or too slow, at that meridian.

Immediately before the Ship sails, repeat these observations, and find again how much the Chronometer is too fast or too slow for mean time: the difference of these errors, when they are both of the same name, or their sum, when of contrary names, will be the whole gain or loss, during the interval between the two observations; therefore to find the daily rate, say, as the interval of time, is to 24 hours, so is the whole gain or loss, to the daily rate.

If the Time-keeper be too fast at the time of the first observation, and the error is increasing, it is evidently gaining on mean time; but if decreasing, it is losing; on the contrary, if the Time-keeper be too slow at the time of the first observation, and the error increasing, it is losing; but if the error be decreasing, it is gaining.

The rate deduced from the comparison of the errors, is founded on the supposition that the motion of the Chronometer is uniform during the interval of time between the observations; but should that not be the case, these observations will not detect its irregularity; it will therefore be prudent to take the observations as frequently as circumstances will permit, by which several rates will be found, differing a little from each other, but the means of these may be considered as the true rate, and employed as such in subsequent observations for finding the longitude.

If any of the rates found as above should differ materially from the rest, they should be altogether rejected, as probably arising from some error in the observations, or irregularities in the going of the Chronometer.

When several observations are taken, by some of which the Chronometer is found to be gaining, and by others losing, take the difference between the sum of all the gainings, and the sum of all the losings, which divide by the number of days elapsed while it is under trial, and the quotient will be the mean rate, of the same denomination with the greater quantity.

The method of finding the rate of a Time-keeper by altitudes taken in the usual way, from the horizon of the sea, is well adapted to the practice of seamen, and if the observations be taken with care and skill, the rate so found may be sufficiently exact for the usual length of a West India voyage: but it must be observed, that if there be an error in the daily rate, since that error accumulates every day, the longitude deduced from the Time-keeper at the end of a long interval may, in that case, be wide of the truth.

The rate may, however, be found nearly as correct as with an astronomical clock, by altitudes taken on shore, with a sextant and an artificial horizon: indeed, these two instruments may be considered a portable observatory, and a person with their assistance will be enabled to regulate Time-keepers, wherever he may chance to stop; and here we must remark, it is not necessary to take the Time-keeper on shore for that purpose; for if the observer has a good pocket watch, that shews seconds, it may be compared with the Chronometer immediately before he goes on shore; and the difference applied to the mean of the times pointed out by the pocket watch, when the altitudes are taken, will be the time by the Chronometer, corresponding to the mean of the altitudes. In fact, the rate of a Chronometer should always be ascertained, if possible, when it is on board ship, where being once fixed it should on no account be removed; for it has been found by experience, that the motion of a Time-keeper is generally accelerated after being received on board, whereby a losing rate will be diminished, and a gaining one increased: this effect has been ascribed to "the magnetic action exerted by the iron in the vessel on the inner rim of the balance, which is made of steel."*

When the motion of a Chronometer is accelerated after its rate has been determined, the longitude resulting from observations made with it will be to the westward of the true longitude, and when its motion is retarded it will give the longitude too far to the eastward.

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* See Mr. Fisher's paper on the errors in longitude, as determined by Chronometers at Sea, read before the Royal Society, June 8, 1820.—Phil. Trans. 1820, p. 207.

We shall now proceed to illustrate the foregoing rules and remarks by a few Examples.

EXAMPLE I.

October 2, a Chronometer was 10m. 42.8s. too fast at noon for mean time at Greenwich, and October 11, at noon, it was 11m. 19.4s. too fast for the same meridian: required the daily rate of the Chronometer.

			m.	s.	
October	2	Chronometer was too fast	10	42.8	
October	11	— too fast	11	19.4	
Interval	9 days	9)	0	36.6	= gain in 9 days.
		Daily rate	0	4.1	gaining.

EXAMPLE II.

At noon, June 13, a Chronometer was 3m. 37s. too fast for mean time at Greenwich, and, at noon, June 25, it was 2m. 13.8s. too fast for the same meridian: required the daily rate of the Chronometer.

			m.	s.	
June	13	Chronometer was too fast	3	37.0	
June	25	— too fast	2	13.8	
Interval	12 days	12)	1	23.2	= loss in 12 days.
		Daily rate	0	6.9	losing.

EXAMPLE III.

February 2, at noon, a Chronometer was 1m. 10s. too fast, and on February 23, at noon, was 0m. 50s. too slow, for Greenwich mean time: required the daily rate of the Chronometer.

			m.	s.	
February	2	Chronometer was too fast	1	10	
February	23	— too slow	0	50	
Interval	21 days		2	0	= loss in 21 days.
			60		
		21)	120		
		Daily rate	5.7s.		losing.

EXAMPLE IV.

November 5, by an observation taken at 4h. 20m. P. M. a Chronometer was found to be 2h. 10m. 45s. too slow; and on November 17, at 7h. 32m. A. M. (civil time), it was 2h. 13m. 36s. too slow at the same meridian: required the daily rate of the Chronometer.

November	5 at	4h. 20m.	Chronometer was too slow	2h. 10m. 45s.
November	16 at	19 32	— — too slow	2 13 36
Interval	11 days	15h. 12m.	Loss during the interval	0h. 2m. 51s.

Then, As 11 days 15h. : 24 hours : : 2m. 51s. : 14.7s.

Hence the daily rate of the Chronometer is 14.7s. losing.

EXAMPLE V.

May 1st, 1830, at Falmouth, in latitude 50° 9′ N. and longitude 5° 2′ W. at 18h. 45m. (being May 2d, at 6h. 45m. A. M. civil time), the following altitudes were taken with an artificial horizon, for the purpose of ascertaining the daily rate of a Chronometer which had been previously set to Greenwich time; the index error of the sextant being 1′ 35″ to be added.

	Times by Chron.			Dble. Alts.		
	h.	m.	s.	°	′	″
	19	10	12	37	48	45
		12	22	38	4	30
		14	33	38	20	15
3)		37	7	114	13	30
	19	12	22	38	4	30
Index error -				+	1	35
2)				38	6	5
Obs. alt. ⊙'s low. l.				19	3	2
Sun's semidiameter				+	15	53
App. alt. ⊙'s center				19	18	55
Refraction — 2′ 44″ Parallax + 8				—	2	36
True alt. ⊙'s center				19	16	19
				90		
Sun's zenith dist.				70	43	41

	h.	m.			
Time at Falmouth -	18	45			
Long. in time -	+	20 W.			
				Const. Log.	9.1249
Greenwich time -	19	5	-	Pro. Log.	0.9746
Daily variation -	18′	4″	-	Pro. Log.	0.9984
	°	′	″		
Variation in 19h. 5m.	+	14	22	Pro. Log.	1.0979
Dec. at noon, May 1	15	0	22 N.		
					25
Sun's reduced dec.	15	14	44 N. -	Secant	0.015534
Latitude -	50	9	0 N. -	Secant	0.193291
Difference -	34	54	16		
Zenith distance -	70	43	41		
Sum -	105	37	57		93
Half sum -	52	48	58	- Sine	9.901202
Difference -	35	49	25		273
Half difference -	17	54	42	Sine	9.487643
				Const. Log.	5.301030
	h.	m.	s.		
Time from noon -	5	12	8	Rising	4.89909
	24				
App. time at Falmouth	18	47	52		
Equation of time -	—	3	7		
Mean time at Falmouth	18	44	45		
Time by Chronometer	19	12	22		
Chron. too fast for merid. of Falmouth		27	37		

May 2d, 1830, at Falmouth, at 18h. 50m. (being May 3d, at 6h. 50m. A. M civil time), the following observations were taken with the same instruments as before, to find the daily rate of the Chronometer.

				h. m.		
			Time at Falmouth -	18 50		
Times by Chron.		Dble. Alts.	Long. in time -	+ 20 W.		
	h. m. s.	° ′ ″			Const. Log.	9.1249
	19 16 47	40 10 30	Greenwich time -	19 10	- Pro. Log.	0.9727
	18 0	23 15	Daily variation -	17′ 50″	- Pro. Log.	1.0040
	19 13	37 0		° ′ ″		
			Variation in 19h. 10m.	+ 14 15*	Pro. Log.	1.1016
	3) 54 0	70 45	Dec. at noon, May 2	15 18 26 N.		
						24
Means	19 18 0	40 23 35	Sun's reduced dec.	15 32 41 N.	- Secant	0.016160
Index error -		+ 1 35	Latitude -	50 9 0 N.	- Secant	0.193291
		2) 40 25 10	Difference -	34 36 19		
			Zenith distance -	69 33 58		
Obs. alt. ☉'s low. l.		20 12 35				
Sun's semidiameter		+ 15 53	Sum -	104 10 17		13
			Half sum -	52 5 8	- Sine	9.897025
Obs. alt. ☉'s center		20 28 28	Difference -	34 57 39		328
Refraction — 2′ 34″ Parallax + 8		— 2 26	Half difference -	17 28 49	- Sine	9.477340
					Const. Log.	5.301030
				h. m. s.		
True alt. ☉'s center		20 26 2	Time from noon -	5 6 17	- Rising	4.88521
		90		24		
Sun's zenith dist.		69 33 58	App. time at Falmouth	18 53 43		
			Equation of time -	— 3 14		
			Mean time at Falmouth	18 50 29		
			Time by Chronometer	19 18 0		

Chronometer too fast for merid. of Falmouth, May 2d	27 31
Ditto May 1st	27 37
Daily loss of Chronometer -	0 6

May 5th, 1830, at Falmouth, at 18h. 45m. (being May 6th, at 6h. 45m. A. M. civil time), the following altitudes were taken with the same instruments as before, to find the daily rate of the Chronometer.

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* See Explanation of Table XXXIV. page xxx.

	Times by Chron.	Dble. Alts.
	h. m. s.	° ′ ″
	19 5 42	38 4 0
	6 55	19 28
	8 5	34 44
3)	20 42	58 12
	19 6 54	38 19 24
Index error -		+ 1 35
	2)	38 20 59
Obs. alt. ⊙'s low. l.		19 10 29
Sun's semidiameter		+ 15 52
Obs. alt. ⊙'s center		19 26 21
Refraction — 2′ 43″ Parallax + 8		— 2 35
True alt. ⊙'s center		19 23 46
		90
Sun's zenith dist.		70 36 14

	h. m.		
Time at Falmouth -	18 45		
Long. in time -	+ 20 W.		
		Const. Log.	9.1249
Greenwich time -	19 5 -	Pro. Log.	0.9746
Daily variation -	17′ 2″ -	Pro. Log.	1.0240
	° ′ ″		
Variation in 19h. 5m.	+ 13 33	Pro. Log.	1.1235
Dec. at noon, May 5	16 11 8 N.		
			25
Sun's reduced dec.	16 24 41 N. -	Secant	0.018039
Latitude -	50 9 0 N. -	Secant	0.193291
Difference -	33 44 19		
Zenith distance -	70 36 14		
Sum -	104 20 33		26
Half sum -	52 10 16 -	Sine	9.897516
Difference -	36 51 55		360
Half difference -	18 25 57 -	Sine	9.499584
		Const. Log.	5.301030
	h. m. s.		
Time from noon -	5 16 47.5 -	Rising	4.90987.
	24		
App. time at Falmouth	18 43 12.5		
Equation of time -	− 3 32		
Mean time at Falmouth	18 39 40.5		
Time by Chronometer	19 6 54		
Chronometer too fast, May 5,	27 13.5		
— May 2,	27 31		
Loss in 3 days - 3)	0 17.5		
Daily rate - -	0 5.8 losing.		

May 7, 1830, at 18h. 35m. the altitude of the Sun's lower limb, taken as before, and corrected for index error was 18° 30′ 37″ when the Chronometer shewed 18h. 59m. 47s. by which it will be found that the mean time at Falmouth was 18h. 3m. 46s. when the Sun's altitude was observed, the Chronometer too fast 27m. 1s. which, compared with its error on May 5, gives its daily rate 6.2s. losing.

Again, May 11, 1830, at 18h. 35m. the altitude of the Sun's lower limb, taken as before, and corrected for index error, was 19° 2′ 23″, when the Chronometer shewed 18h. 57m. 34s. which gives the error of the Chronometer for the meridian of Falmouth 26m. 36s. too fast, and the daily rate 6.2s. losing.

From the preceding observations, the mean rate may be determined as follows:

			m.	s.				s.		Daily rates. s.
May	1	Chronometer was too fast	27	37						
—	2	— — too fast	27	31	—	loss in	1 day	6.0	=	6.0
—	5	— — too fast	27	13.5	—	loss in	3 days	17.5÷3	=	5.83
—	7	— — too fast	27	1	—	loss in	2 days	12.5÷2	=	6.25
—	11	— — too fast	26	36	—	loss in	4 days	25.0÷4	=	6.25
						Loss in	10 days	61.0	4)	24.33
								Mean daily rate		6.08

Or 61.0s. the total loss, divided by 10, the number of days elapsed between the first and last observations, gives the mean daily rate 6.1s.

Hence it appears that on May 11, at 18h. 57m. 34s. (May 12th at 6h. 57m. 34s. A. M. civil time) the Chronometer was too fast at the meridian of Falmouth 26m. 36.0s. and losing daily 6.1s.

Or if the longitude of Falmouth in time (20m. 8s. W.) be added to 18h. 30m 58.0s., the mean time at Falmouth when the observation was made May 11th, it will give the mean time at Greenwich 18h. 51m. 06.0s., which subtracted from 18h. 57m. 34s. shews that the Chronometer was 6m. 28.0s. too fast at the meridian of Greenwich.

It is essential, that the altitudes used for finding the rate of a Chronometer should be observed about the same time of each day, or that the proportional part of the gain or loss should be found; for as the daily rate is the loss or gain in 24 hours, it follows, that if one observation, for instance, be taken in the morning, and another in the afternoon of the following day, the interval being more than a complete day of 24 hours, the difference of the times by the Chronometer will be more than the daily rate: let us suppose that the above series of observations were continued, and that on May 13th, altitudes were taken in the afternoon, by which it appeared, the mean time at Falmouth was 5h. 15m. 33s. P. M. when the Chronometer shewed 5h. 42m. 00s. and was therefore 26m. 27s. too fast for mean time, when the observations were taken.

May	11d.	18h.	30m.	58s.	Chronometer was too fast	26m.	36s.
May	13	5	15	33	- - -	26	27
Interval	1	10	44	35	Diff.		9

The Chronometer therefore lost 9s. in 1 day 10h. 45m. = 34h. 45m. or 35 hours nearly: consequently, as 35h. : 9s. : : 24h. : 6.2s., the daily rate required.

Three or more Chronometers may be compared together daily, and a judgment thence formed of the regularity of their going: as, for instance, suppose the comparison be made each day about noon, with three Chronometers: the assumed rate of No. 1. being 5s. gaining; of No. 2, 2s. gaining; and of No. 3, 3s. losing; let the comparisons be made as in the following tables:

Comparison of No. 2. with No. 1.

Mon	Days.	Chr. No 1	Chr. No 2	First diff.	Sec. diff.
		h. m. s.	h. m. s.	m. s.	s.
May	1	0 10 40	0 20 32	9 52	
	2	0 12 30	0 22 25	9 55	3
	3	0 15 20	0 25 18	9 58	3
	4	0 11 35	0 21 36	10 1	3
	5	0 13 5	0 23 9	10 4	3
	6	0 8 50	0 18 57	10 7	3
	7	0 14 45	0 24 55	10 10	3
	8	0 20 35	0 30 48	10 13	3
	9	0 15 10	0 25 26	10 16	3
	10	0 16 0	0 26 19	10 19	3

Daily gain of No. 1 . . 5s.
Daily gain of No. 2 . . 2

Daily diff. should be . 3

Comparison of No. 3. with No. 1.

Mon	Days.	Chr. No 1	Chr. No 3	First diff.	Sec. diff.
		h. m. s.	h. m. s.	m. s.	s.
May	1	0 11 10	0 6 45	4 25	
	2	0 13 0	0 8 27	4 33	8
	3	0 16 10	0 11 30	4' 40	7
	4	0 11 55	0 7 9	4 46	6
	5	0 13 50	0 8 56	4 54	8
	6	0 9 15	0 4 14	5 1	7
	7	0 15 20	0 10 10	5 10	9
	8	0 20 50	0 15 32	5 18	8
	9	0 15 55	0 10 31	5 24	6
	10	0 16 40	0 11 7	5 33	9

Daily gain of No. 1 . . 5s.
Daily loss of No. 3 . . 3

Daily diff. should be . 8

Comparison of No. 3. with No. 2.

Mon	Days.	Chr. No 2	Chr. No 3	First diff.	Sec. diff.
		h. m. s	h. m. s.	m. s.	s.
May	1	0 21 30	0 7 43	13 47	
	2	0 23 25	0 9 33	13 52	5
	3	0 26 10	0 12 14	13 56	4
	4	0 22 35	0 8 36	13 59	3
	5	0 24 10	0 10 6	14 4	5
	6	0 19 55	0 5 47	14 8	4
	7	0 25 10	0 10 56	14 14	6
	8	0 31 0	0 16 41	14 19	5
	9	0 26 10	0 11 48	14 22	3
	10	0 27 35	0 13 7	14 28	6

Daily gain of No. 2 . . 2s.
Daily loss of No. 3 . . 3

Daily diff. should be . 5

Now by comparing No. 2. with No. 1. we find that it is regularly gaining daily 3s. on No. 1. equal to the difference of their rates; again, No. 3. being compared with No. 1. their daily difference, which should be 8s., the sum of their daily rates, because one is gaining and the other losing, appears to be irregular; and, lastly, No. 3. compared with No. 2. gives also irregular differences, which should be 5s. the sum of their rates; hence we conclude, that No. 1. and No. 2. are going steadily, but that No. 3. is going very indifferently.

In winding up a Chronometer that is going, great caution should be observed, not to give it circular motion, which would alter its rate some seconds, or, perhaps, even stop its going; but when a Chronometer is once suffered to run down, it will not acquire new motion, without giving it two or three quick horizontal circular turns; and it must be observed, that when it has once stopped, though for ever so short a period, it will not recover the regularity of its motion for some days after, and consequently no reliance can be placed in its performance, until its rate be proved the same as before it stopped.

A Chronometer should be wound up regularly at the same time of the day, and great care taken not to give the key, first half a turn, then a whole turn, afterwards three quarters, and so on; for this irregular mode of winding up, will sometimes very materially alter its rate, and should be as carefully avoided as circular motion: it is therefore advisable to turn the key always half round at a time. The Chronometer should also be examined before the case is shut, to ascertain whether it continues going, as sometimes, when wound up in haste, and the chain overstrained, it will be liable to stop.

Time-keepers are of great utility in carrying on the longitudes deduced from lunar distances from one day to another, so that the results of a number of observations may be brought to one point of time. Also, the apparent time found by altitudes taken at a proper distance from the meridian, being carried on by the Chronometer, will answer for any lunar observation taken in the course of 24 hours; in fact, whenever it is requisite to measure short intervals of time accurately, or to ascertain the difference of longitude between adjacent places, these instruments are of the greatest importance.

The method of carrying on or deducing the time of taking distances, to the time of taking altitudes for the Chronometer may be illustrated as follows: suppose that altitudes are taken in the morning for ascertaining the longitude by Chronometers, and that a set of lunar distances be observed in the afternoon; take the elapsed time, as measured by the Chronometer, from observing the altitudes to that of observing the distances, and when the time at Greenwich is deduced from the distances, subtract this elapsed time from it, and the remainder will be the time at Greenwich when the altitudes were taken in the morning, and will produce the longitude at that time, and not when the distances were observed. On the contrary, if a set of lunar distances are taken before the altitudes are observed to find the apparent time, then the elapsed time must be added to the Greenwich time, to bring the longitude to the time when the altitudes were taken.

Or, which is precisely the same thing, ascertain by the altitudes how much the Chronometer is too fast or too slow at the meridian of the place of observation: this error being applied to the mean of the times, by the same Chronometer, when the distances are observed, will reduce the longitude by the lunar observation to the meridian where the error was ascertained; consequently, will give the longitude of the ship when the altitudes were observed.

EXAMPLE.

June 6, 1830, a set of altitudes were taken in the morning, which gave the apparent time at Ship 20h. 14m. 16s., when a Chronometer, having no rate, shewed 22h. 15m. 32s. from noon the same day; and June 7, at 2h. 19m. 45s. by the same Chronometer, a set of distances were observed, which gave apparent time at Greenwich 2h. 41m. 17s.; required the longitude when the altitudes were taken for the Chronometer.

	h.	m.	s.
Time by Chronometer when the altitudes were observed	22	15	32
Time by Chronometer when the distances were observed	26	19	45
Interval by Chronometer	4	4	13
App. time at Greenw. when the distances were observed	26	41	17
App. time at Greenwich when alts. were taken for Chron.	22	37	4
App. time at Ship when alts. were taken for Chronometer	20	14	16
Longitude when altitudes were taken for Chronometer	2	22	48=35° 42′ W.

Or thus,

	h.	m.	s.
Time by Chronometer when the altitudes were observed	22	15	32
App. time at Ship, when altitudes were taken for Chron.	20	14	16
Chronometer too fast at that Meridian	2	1	16
Time by Chron. when the distances were observed	26	19	45
App. time at the Meridian where the altitudes were taken, when the distances were observed	24	18	29
App. time at Greenw. when the distances were observed	26	41	17
Longitude when alts. were taken for Chronometer	2	22	48=35° 42′ W

Observations of lunar distances may be carried on from one time to another, so that when the observer has obtained a number of sets on each side of the Moon, he may bring them all to one point of time, by the Chronometer, and thereby get a mean of all the observations, which will give very nearly the true longitude, if the observations are carefully made. This may be explained as follows: suppose on January 20th, six sets of lunar distances be observed; on the 21st, four more; and on the 23d, being the last day when the distances are set down in the Nautical Almanac, on that side of the Moon, six more sets be observed. Bring each set of distances to the time when the altitudes for Chronometers were taken on their respective days; then take the difference of longitude shewn by the Chronometer between the 20th and the 23d, at the time the altitudes for the Chronometer were observed, which apply to each set taken on the 20th; do the same between the 21st and 23d; each set will then be brought on to the time when altitudes for the Chronometer were taken on the

23d; in all sixteen sets. The mean of these observations will, in all probability, not be far from the truth. In this manner, observations may be carried on by distances taken on the other side of the Moon, and the result deduced from their mean will approximate still nearer to the truth. Thus the lunar observations and Chronometers may be made to go hand in hand with each other, to discover the ship's true longitude.

EXAMPLES FOR EXERCISE.

I. July 8, 1830, P. M. in latitude 47° 46′ N. the observed altitude of the Sun's lower limb was 26° 32′ 17″, when a Chronometer shewed 2h. 50m. 15s. P. M.; whose error and rate had been determined at noon, June 25th, when it was fast on Greenwich mean time 2m. 13.8s. and losing 6.9s. daily; the error of the sextant being + 5′ 10″, and the height of the eye 28 feet: required the longitude of the Ship.

Answer. Mean time at Ship 5h. 2m. 16s.; mean time at Greenwich 2h. 49m. 32s. and the longitude 33° 11′ 0″ East.

II. October 11, 1830, at noon, a Chronometer was fast on Greenwich mean time 11m. 19.4s. and was gaining 4.1s. per day.

October 21, A. M. (civil time), in latitude 34° 37′ S. the same Chronometer shewed 6h. 42m. 10s. A. M. when the observed altitude of the Sun's lower limb was 42° 19′ 52″; the index error being 2′ 30″ to subtract, and the height of the eye 20 feet: required the longitude.

Answer. Mean time at Ship, October 20, 20h. 44m. 27s.; mean time at Greenwich 18h. 30m. 11s.; and the longitude 33° 34′ 0″ E.

III. August 7, 1830, at noon, a Chronometer was slow on mean time at Greenwich 17m. 30s.; and on August 13, at noon, it was slow on mean time, at the same meridian, 18m. 45s.

August 23, A. M. (civil time), in latitude 37° 40′ N., when the above Chronometer shewed 5h. 53m. 16s. (being P. M. at Greenwich), the observed altitude of the Sun's lower limb was 37° 15′ 40″, the index error of the sextant being 2′ 15″ to subtract, and the height of the eye 20 feet: required the longitude.

Answer. The daily rate of the Chronometer was 12.5s. losing; the mean time at Ship 20h. 37m. 33s., and the mean time at Greenwich 30h. 14m. 9s. past noon, August 22d: the longitude 144° 9′ 0″ West.

IV. January 2, 1830, at noon, a Chronometer was 1h. 12m. 52.5s. slow on mean time at Greenwich; and on January 9, at noon, it was 1h. 13m. 57s. slow on mean time at the same meridian.

January 30, P. M. in latitude 30° 20′ N. when the above Chronometer shewed 2h. 39m. 51s. (being January 30, A. M., civil time, at Greenwich), the observed altitude of the Sun's lower limb was 17° 42′ 54″, the index error being 3′ 15″ to add, and the height of the eye 20 feet: required the longitude.

Answer. The daily rate of the Chronometer was 9.2s. losing; the mean time at Ship 27h. 56m. 52.s, and the mean time at Greenwich 15h. 56m. 58s., past noon, January 29; the longitude 179° 58′ 30″ E.

V. February 6, 1830, at noon, a Chronometer was 27m. 54.5s. fast on mean time at the Cape of Good Hope, in longitude 18° 32′ E, and February 13, at noon, it was 29m. 10s. fast at the same meridian.

March 3, about 5h. 58m. P. M., being in latitude 48° 57′ N. the altitude of the Star Regulus was observed to be 17° 42′ 16″, when the above Chronometer shewed 3h. 10m. 36s. P. M.; the error of the sextant being + 2′ 10″, and the height of the eye 25 feet: required the longitude.

Answer. The daily rate of the Chronometer was 10.8s. gaining; the mean time at Ship 6h. 4m. 57s.; the mean time at Greenwich 1h. 24m. 2s., and the longitude 70° 13′ 45″ East.

VI. September 9, 1830 (civil time), at Bombay, in latitude 18° 56′ N. and longitude 72° 54′ 24″ E. about 7h. 20m. A. M., the double altitude of the Sun's lower limb was observed to be 38° 37′ 55″ by an artificial horizon, when a Chronometer shewed 2h. 31m. 58s. A. M.; and on September 16, about 7h. 24m. A. M., the double altitude of the Sun's lower limb was again observed to be 33° 42′ 0″, when the same Chronometer shewed 2h. 23m. 54s. A. M. the error of the sextant being — 2′ 10″: required the rate of the Chronometer, and its error on Greenwich mean time, when the latter altitude was observed.

Answer. The Chronometer was 11m. 9s. fast on Greenwich mean time on September 9, and 12m. 22s. fast on September 16, hence the daily rate was 10.4s. gaining.

VII. May 4, 1830, at Kingston, Jamaica, in latitude 18° 1′ N. and longitude 76° 45′ W. about 4h. 30m. P. M. the double altitude of the Sun's lower limb, taken by an artificial horizon, was 49° 34′ 35″, a Chronometer, No. 65, shewing at the same time 9h. 30m. 28s. P. M.; and on May 12, about 4h. 36m. P. M. the double altitude of the Sun's lower limb was 49° 35′ 50″, when No. 65 shewed 9h. 31m. 51s.; the index error of the sextant being + 1′ 15″: required the rate of the Chronometer and its error on Greenwich mean time when the latter altitude was taken.

Answer. The Chronometer was 6m. 23s. slow on mean time at Greenwich on May 4, and 6m. 25s. slow on May 12; hence the daily rate was 0.3s. losing.

METHOD OF KEEPING

A

JOURNAL AT SEA.

A Sea Journal is a book wherein is registered an exact and regular account of the various occurrences that happen on board a Ship during her voyage; but more particularly those concerning the Ship's way, in order that her situation may be known at any time required.

For this purpose there is kept in the steerage, or some other convenient part of every Ship, a large board, painted black, called the Log Board, which is usually divided into six columns; the first, on the left hand, contains the 24 hours from the noon of one day to the noon of the following; the second and third columns are for the knots and fathoms the Ship runs in half a minute, or the miles and tenths in an hour*; the fourth column contains the courses steered by the Compass; in the fifth the winds are entered; and in the sixth, the various remarks, such as the state of the weather, the sails set or taken in, the observations made for ascertaining the Ship's place, the variation of the Compass, and whatever else may be thought necessary. All these particulars are entered every day at noon into a book, divided into columns exactly like the log board, and called the Log Book. From this book the Navigator makes the necessary deductions, relating to the Ship's place, every day at noon; which operation is called doing a Day's Work.

While the Ship is in port, the remarks entered in the log book are called Harbour Work; and the account of the Ship's way, &c. kept at sea, is termed Sea Work.

In Harbour Work the day is estimated according to the civil reckoning, as on shore; that is, from midnight to midnight; but at sea, the days' works being made up at noon, are dated the same as the civil day, so that the days' works marked Monday, began on Sunday at noon, and ended on Monday at noon; hence the day by the Ship's reckoning, which is called the Nautical Day, begins twelve hours before the civil day †: the first twelve hours, or those contained between noon and midnight, being marked P.M., signifying post meridian, or afternoon, and the other twelve hours, A.M., signifying ante meridiem, or before noon *.

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* In the Royal Navy, and Ships in the service of the East India Company, the log is hove every hour, but in most trading Vessels only once every two hours. This last circumstance makes no difference in the computation, excepting that the knots and fathoms run on every course by the log, must be doubled, to give the whole distance.

† In compliance with a late order from the Admiralty, the Navy Logs are dated at midnight, in order to correspond with the civil reckoning.

When a Ship is bound from one place to another that lies so far from her that she is obliged to leave the land, at the time of losing sight of it, the bearing of some place is to be observed, whose Latitude and Longitude are known; which, together with the estimated distance of the Ship from the land, is to be set down on the log board. This is called *taking a Departure.* The distance may, however, be more accurately known by taking the bearing twice, and noting the Ship's course and distance between them, as shewn in the first example of Oblique Sailing.

TO CORRECT THE COURSES STEERED BY COMPASS.

The Variation of the Compass, which is usually found by observation, as already explained, must be applied to all courses steered, and on all bearings taken by the Compass, in the following manner. Suppose yourself placed at the center of the Compass, and looking directly forward to the point you are to allow the variation from; then, if the variation be easterly, allow it to the right hand of the course steered, or bearing taken by Compass; but if westerly, to the left hand; by which you will obtain the true course.

For example, suppose the course steered by Compass is N.E. by N. and the variation is 1 point westerly; now, 1 point to the left hand of N.E. by N., is N.N.E., which is the true course required. Again, suppose I set a Cape, and find it bear from me S. W. by Compass, the variation being 1½ point easterly: here 1½ point allowed to the right hand of S. W. will give S.W. by W. ½ W., the true bearing of the land.

The courses must likewise be corrected for leeway, the nature of which may be thus explained. When a Ship is close hauled, and the wind blowing fresh, that part of the wind which acts upon the hull and rigging, together with a considerable part of the force exerted on the sails, tend to drive her immediately from the direction of the wind, or, as it is termed, to leeward. But since the bow of a Ship exposes less surface to the water than the side, the resistance will be less in the first case than in the second; the velocity, therefore, in the direction of her head, will, in most cases, be greater than the velocity in the direction of her side, and the Ship's course will be between the two directions. Now the angle contained between the line of the Ship's apparent course, and the line she really describes through the water, is termed her LEEWAY.

The quantity of leeway to be allowed will depend upon a variety of circumstances; as the mould or trim of the Ship; the quantity of sail she carries; her velocity through the water, &c.: hence no general rules can be laid down with accuracy that will determine the quantity of leeway at all times. The following have, however, been usually given by most writers on Navigation.

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* As the Astronomical Day begins at noon of the civil day, which is the end of the nautical day, the declination of the Sun, used in determining the latitude by a meridian altitude, is taken out from the Tables, or Almanac, for the noon of the civil day.

1. When the Ship is close-hauled, has all her sails set. the water smooth, with a light breeze of wind, she is then supposed to make little or no leeway.
2. When the top-gallant sails are handed, allow one point;
3. When under close-reefed topsails, allow two points;
4. When one top-sail is handed, allow two points and a half;
5. When both top-sails are handed, allow three points and a half.
6. When the fore-course is handed, allow four points;
7. When under the main-sail only, allow five points;
8. When under the balanced mizen, allow six points;
9. When under bare poles, allow seven points.

As these allowances depend entirely on the quantity of sail set, without regard to any other circumstance, it is evident they can only be considered as probable conjectures, and may indeed serve to work up the day's work of a Journal that has been neglected. But since the computation of a Ship's way depends much upon the accuracy of this allowance, it should always be the duty of the Officer of the Watch carefully to observe the leeway, and either allow it upon the courses steered, before they are put down on the Log-board, or else set it down in a column reserved for that purpose.

The leeway that a Ship makes may be easily estimated thus: Draw a small semicircle on the taffrail, with its diameter at right angles to the Ship's length, and divide its circumference into points and quarters; then observe the angle contained between the semidiameter which points right aft, and that which points in the direction of the wake, and it will be the leeway required. But the most accurate method of determining the leeway is, to have a semicircle drawn on the taffrail, as before described, with a low crutch or swivel in its center. Then, after heaving the log, the line is to be slipped into the crutch just before it is drawn in, and the points and quarters contained between the direction of the log line and the fore and aft line of the semicircle, will be the leeway.

The leeway being determined, is to be allowed from the wind, that is, to the right hand of the course steered, when the larboard tacks are aboard, and to the left hand when the starboard tacks are aboard*, supposing yourself looking from the center of the Compass towards that point the Ship's head is directed to. For example; suppose a Ship sails S. W. by S. by Compass, with her starboard tacks aboard, and she makes one point leeway; her course corrected for leeway will be S. S. W. being one point to the left of her course by Compass. Again, if a Ship close-hauled sails N. E. when the wind is N. N. W., and makes 1½ point leeway, her true course will be N. E. by E. ½ E.; because, having her larboard tacks aboard, 1½ point is to be counted to the right hand of the course by Compass.

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* When a Ship is close hauled, certain ropes, called *tacks*, which are fastened to the lower corners of the main and foresails, are hauled forward on the weather side, or that next the wind, in which case those tacks are said to be aboard. When a Ship is close-hauled, with the wind on the right hand, she has her starboard tacks aboard, and is said to sail on the starboard tack. But if the wind be on the left hand in the same manner, she has her larboard tacks aboard, and is said to sail on the larboard tack.

The Examples in the following Table, where the courses steered, with the leeway and variation to be allowed on each, are given, from thence to find the true courses, will serve to exercise the learner in the foregoing rules.

Given.				To find.
Courses steered.	Winds.	Leeway.	Variation.	Courses corrected.
E. N. E.	N. W.		1½ W.	N. E. ½ E.
W. by S.	N. W. by N.	1		W. S. W.
N. W. by N.	N. E. by N.	1½	2 W.	W. N. W. ½ W.
South.	E. S. E.	½	1¼ E.	S. by W. ¾ W.
N. W.	W. S. W.	2	1 W.	N. W. bv N.
S. S. W.	S. E.	1¼	1¼ W.	S. S. W.
E. by N.	N. by E.	2½	0¾ E.	S. E. by E. ¾ E.
West.	N. N. W.	¾	1 E.	W. ¼ N.

In hard blowing weather, with a contrary wind and a high sea, it is impossible to gain any advantage by sailing; in such cases, therefore, the object is to avoid, as much as possible, being driven back. With this intention it is usual to ly-to under no more sail than is sufficient to prevent the violent rolling which the Vessel would otherwise acquire, to the endangering the masts and rigging. When a Ship is brought-to, the tiller is put over to the leeward, which brings her head round to the wind. The wind then having very little power on the sails, the Ship looses her way through the water, which ceasing to act upon the rudder, her head falls off from the wind, the sail which she has set fills, and gives her fresh way through the water; which, acting on the rudder, brings her head again to the wind. Thus, the Ship has a kind of vibratory motion, coming up to the wind, and falling off from it alternately.

When a Ship is lying-to, observe the points on which she comes up and falls off, and take the middle point for the apparent course; from which allow the variation and leeway, and you will have the true course. For example, suppose a Ship lying-to under a main sail, with her starboard tacks aboard, comes up E. by S. and falls off N. E. by E., there being one point westerly variation, and she makes 5 points leeway; what course does she make good? The middle point between E. by S. and N. E. by E. is E. by N., from which allowing 5 points to the left hand, because the starboard tacks are aboard, gives the course, corrected for leeway, N. N. E.; from which allowing one point to the left hand, because the variation is westerly, will give the true course N. by E.

In sailing along a Coast, in a tide or current, particular care should be taken to observe its setting, which, with the variation allowed, is to be entered in the Traverse Table as a course, and its drift as a distance; the same is to be observed for the heave or swell of the Sea.

On leaving the land, the opposite point to its bearing from the Ship, with the variation allowed, and the estimated distance from it, are to be set down in the Traverse Table as a course and distance.

The computation made from the several courses, corrected as above, and their corresponding distances, is called a DAY'S WORK; and the Ship's Latitude and Longitude, as derived therefrom, is called her Latitude and Longitude by ACCOUNT or DEAD RECKONING.

If the course and distance made good by a Ship, as estimated from the Compass and the Log, could be accurately ascertained, nothing more would be necessary in determining a Ship's place at any time during her voyage; for the course and distance being known, the difference of Latitude and Longitude, and hence the Latitude and Longitude in, may be readily found by any of the methods shewn in the various Sailings; but on account of the many accidents that attend a Ship's way, such as swelling of the Sea; different rates of sailing between the times of heaving the log; want of care at the helm; unknown currents; sudden squalls; improper allowances for variation and leeway, &c.; the Latitude of the Ship, as deduced from the reckoning, will frequently differ considerably from the Latitude by observation, and hence the difference of Longitude and Longitude in will be likewise erroneous. Now, as the Latitude by observation is always depended on, it remains therefore to correct the Ship's Longitude by account. For this purpose, examine whether the log-line and half-minute glass be just, and if you find they are not, correct the distance by the rules in pages 63 and 64, and with the corrected distance and the course, find a new difference of Latitude and Departure; then, if this difference of Latitude applied to the Latitude left gives a Latitude nearly the same as by observation, the error may be considered as sufficiently corrected, and the difference of Longitude is to be found with this new Latitude or Departure. But if there still remains a considerable difference between the Latitudes by account and by observation, consider carefully if the leeway and variation have been properly allowed; whether the Ship's motion may not have been affected by a current, or heave of the sea; and if so, make the best estimation you can for its setting and drift.

If, after all proper allowances are made for errors in distance, currents, &c. the Latitude by account and observed Latitude should still disagree, it is then recommended by some Authors to correct further for supposed errors in the courses and distances. Thus, if the course be near the meridian, the error is supposed to arise from the distance, because the error in the course must be sensible to make any considerable error in the difference of Latitude; if the course be nearly east or west, then the error is supposed to result from the course, as an error in the distance must be very great to make a considerable one in the Latitude; but if the course be near 4 points, then the error in the Latitude is attributed partly to the course and partly to the distance. The rules founded upon these suppositions, it must be confessed, are, in general, little better than guess work: however, as they may be sometimes useful, we think it proper to introduce them here, with examples worked by Inspection.

RULES FOR CORRECTING THE DEAD RECKONING.

CASE I.

When the Error is supposed to arise from the Distance.

Rule. With the course found by the difference of Latitude and Departure by account, and the meridional difference of Latitude between the observations, find the difference of Longitude.

EXAMPLE.

Yesterday at noon we were in Latitude 39° 18′ N., and by observation this day at noon we are in Latitude 37° 48′ N., having made by our reckoning 107 miles of southing, and 64 of westing: required the true difference of Longitude.

The difference of Latitude 107 and Departure 64 give the course $2\frac{3}{4}$ points; then with the same course and the meridional difference of Latitude between the two observations 115, the difference of Longitude is found to be 69 miles.

CASE II.

When the Error is supposed to arise from the Course.

Rule. With the difference of Latitude and Departure by account find a distance; with this distance and the difference of Latitude by observation find a course; then with this course and the meridional difference of Latitude between the two observations find the true difference of Longitude.

Or, with the distance by account and difference of Latitude by observation find a corresponding Departure; with which and the Co. Middle Latitude between the observations find the true difference of Longitude.

EXAMPLE.

Yesterday at noon we were in Latitude 38° 52′ N.; to-day at noon we are in Latitude 40° 18′ N., and by account we have made 68 miles of northing, and 212 of westing: required the true difference of Longitude.

With the difference of Latitude 68 and the Departure 212, the distance is found to be 223; the distance 223 and the difference of Latitude by observation 86, give the true course 67°; this course and the meridional difference of Latitude by observation 111, give the true difference of Longitude 261 miles.

Or, the distance by account 223 and the difference of Latitude by observation 86 give the true Departure 205; the Co. Middle Latitude between the observations 50° 25′, and the Departure 205, give the correct difference of Longitude 266 miles.

CASE III.

When the Error is supposed to arise both from the Course and Distance.

Rule. With the difference of Latitude and Departure by account find a distance; with that distance and the difference of Latitude by observation find a corresponding Departure; which add to the Departure by account, and take half their sum for the true Departure. With the true Departure and the difference of Latitude by observation find the true course; with which and the meridional difference of Latitude by observation find the true difference of Longitude.

EXAMPLE.

Yesterday at noon we were in Latitude by observation 52° 40′ N. and are this day at noon in Latitude 54° 22′ N. having made by account 84 miles of northing and 76 of westing: required the true difference of Longitude.

The difference of Latitude 84 and Departure 76 give the distance 113; with this distance and the difference of Latitude by observation 102, the corresponding Departure is 47.8, which added to 76, the Departure by account, is equal to 123.8, half of which is 61.9, the true Departure; then with the true Departure 61.9 and the difference of Latitude by observation 102, the true course is found to be 31°: this course and the meridional difference of Latitude between the two observations 171, give the true difference of Longitude 103 miles.

To correct for several Days.

Enter in a Traverse Table the difference of Latitude and Departure made good each day since last observation, including those for the day you correct on; whence you will have the whole difference of Latitude and Departure since last observation, with which find the course since last observation, and correct accordingly by one of the preceding cases.

Notwithstanding the above corrections be applied with the greatest care to the Ship's reckoning, it is frequently found, on making the land after a long voyage, that the Longitude by dead reckoning differs several degrees from the truth; a good Navigator will therefore lose no opportunity of ascertaining the Longitude by observation; and when this is done, the account of Longitude is to be carried forward from the last observation in the same manner as that of the Latitude. A separate account is usually kept of the Longitude by dead reckoning and of that by observations.

GENERAL RULES FOR WORKING A DAY'S WORK.

1. Enter in a Traverse Table the several courses steered, corrected for variation and leeway; and opposite each course place the whole distance run as it appears by the log on summing up the knots and fathoms while the Ship is on that course. Find the difference of Latitude and Departure answering to each course and distance, and set them down in their respective columns; then the difference between the sums of the northings and southings will be the difference of Latitude made good, of the same name with the greater; and the difference between the sums of the eastings and westings will be the Departure made good, of the same name with the greater quantity.

2. Seek in the Traverse Table until the above difference of Latitude and Departure are found together in their respective columns; opposite to these will be the distance made good, and at the top or bottom of the page, according as the Departure is less or greater than the difference of Latitude, will be found the course.

3. If the Latitude from which the Ship's Departure is taken, or yesterday's Latitude, be of the same name with the difference of Latitude, add them together; if not, take their difference; the sum or remainder will be the present Latitude, of the same name with the greater.

4. Find the complement of the Middle Latitude between yesterday's and to-day's Latitude, which take as a course in the Traverse Table, and seek for the Departure in its column; then will the distance corresponding to these be the difference of Longitude, of the same name as the Departure.

Or, seek for the course made good, and for the meridional difference of Latitude in a Lat. column; then will the corresponding Departure give the difference of Longitude as before.

5. If the Longitude of yesterday be of the same name with the difference of Longitude, add them together; if not, take their difference; the sum or remainder will be the Longitude in, of the same name with the greater.

6. To find the bearing and distance of the intended port, or any other place, from the Ship, find the complement of the Middle Latitude between the Ship and the proposed place; which seek in the Traverse Table as a course; in that page where it is found, look for the difference of Longitude in a distance column, opposite to which will be the Departure in its proper column; with this Departure

and the difference of Latitude, find the course or bearing, and the distance as before.

Or, look for the meridional difference of Latitude and difference of Longitude, till they are found opposite each other in the Lat. and Dep. columns, and they will give the course; this course and the proper difference of Latitude in the Lat. column, will give the distance in its proper column.

If the magnetic course or bearing be required, the variation must be allowed on the true bearing; to the right-hand, if the variation be westerly, or to the left-hand, if easterly.

There are various methods of keeping a Sea Journal, with regard to what deserves to be recorded, according to the sentiments of different persons; some approve of a Journal including the Log Book, each day's work at some length, and such occurrences as seem of most importance; while others prefer a short abstract of this long Journal, containing little more than the course and distance run, the Latitude and Longitude in, and sometimes the bearing and distance to the intended port, for each day. There are likewise forms peculiar to the particular service to which a Ship belongs, as in the Royal Navy and East India Service. These forms will be shewn hereafter.

We shall now proceed to exemplify the above Rules; first by a few examples of separate Days' Works, and afterwards in a Journal from London to Madeira, kept in the form generally used in Merchant Ships, and containing most of the occurrences that happen to a Ship in a common voyage.

NOTE. In the following Days' Works and Journal, which are worked by Inspection. the log is supposed to be hove every hour and the knot divided into eight fathoms of six feet each.

EXAMPLE I.

Yesterday, at noon, we were, by observation, in latitude 19° N., and in longitude 23° 4′ W.; and have sailed till noon this day, as per log; the variation of the Compass being 1 point west: required the course and distance made good, and the present latitude and longitude of the Ship.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks.
1	5	4	S. W. $\frac{1}{2}$ W.	N. E.		Moderate and clear.
2	5	2				
3	5	4				
4	5					
5	5					
6	5					
7	4	6	- -	- -	-	Cloudy.
8	4					
9	4					
10	4					
11	3	4				
12	3	4				
1	4		N. W.	E. N. E.		
2	4					
3	3	2				
4	3					
5	3	6	S. W.	- -	-	Set the fore-top-mast steering-sail.
6	5	2				
7	5	4	S. S. W.	- -	-	An increasing breeze and fair.
8	6					
9	7					
10	8					
11	7	4				
12	7					Variation 1 point West.

Courses.	Dist	N.	S.	E.	W.
S. W. $\frac{1}{2}$ S.	55		42.5		34.9
N. W. by W.	14	7.8			11.6
S. W. by S.	9		7.5		5.0
S. by W.	41		40.2		8.0
		7.8	90.2	Dep	59.5
			7.8		
	Diff. lat.		82.4		

Lat. left -	19°	0′	N.	-	Mer. Parts 1161
Diff. of lat.	1	22	S.		
Lat. in -	17	38	N.	-	Mer. Parts 1075
Sum of lats.	36	38			
Middle lat.	18	19			Mer. diff. lat. 86
	90				
Co. mid. lat.	71	41			

The first course steered by Compass, viz. S. W. $\frac{1}{2}$ W., being corrected for 1 point west variation, makes the true course S. W. $\frac{1}{2}$ S.; and the knots and fathoms, summed up to midnight, give the distance run upon the first course, 55 miles: in the same manner the other courses are to be corrected, and, with their corresponding distances, are to be set down in a Traverse Table, as above. No leeway is allowed on the courses in this day's work, because the Ship is going large.

The whole difference of latitude 82.4, and the departure 59.5, give the course made good S. 36° W., and the distance 102 miles.

The co. middle lat. 71° 41′ as a course, and the departure 59.5 in a dep. column, give the diff. of longitude 62′ in a dist. column, by Middle Latitude Sailing.

Or, the course 36°, and mer. diff. of latitude 86′ in a lat. column, give the diff. of longitude 62′ in a dep. column, by Mercator's Sailing.

The difference of longitude 62 miles, or 1° 2′ W., added to the longitude of yesterday, 23° 4′ W., because they are both of the same name, gives the longitude in to-day 24° 6′ W.

EXAMPLE II

Yesterday, at noon, we were in latitude 35° 2′ N., and longitude 17° 45 W.; at 7 o'clock, P. M the Sun was observed to set W. 43° N. by Compass, his declination being at that time 18° 56′ N.; and we have sailed this day till noon, as per log, in a current setting S. W. 1 mile per hour all day: required the course and distance made good, and our present latitude and longitude.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks.
1	5		N. E. by N.	E. S. E.		Moderate breezes.
2	5	2				
3	5	2				
4	5					
5	5	4				
6	5					
7	4	6	- -	- -		The Sun set W. 43° N.
8	4	2				
9	5					
10	5					
11	5	2	N. N. E.	East.	1	Fresh gales. In 2d reef of the topsails.
12	5					
1	4	6				
2	4	2				
3	3	6				
4	3	4	N.E.byN.½E.	E. by S.	1½	
5	3					
6	3					
7	3					
8	2	4	- -	- -		Cloudy.
9	2					
10	2	4				
11	2	4				
12	2					

Before the courses can be corrected, the variation of the Compass must be found by the amplitude taken at Sun-set. Now the Ship's course from noon to 7 o'clock is N. E. by N., and the distance run 36 miles: but allowing the variation at last observation to be about 1½ point westerly, the corrected course will be N. by E. ½ E.; with which, and the distance 36 miles, the diff. of latitude made good since noon is found to be 34′ N.: this, added to the latitude at noon, 35° 2′ N., gives the latitude in, at Sun-set, 35° 36′ N.; with which, and the declination 18° 56′ N., the true variation is found as follows.

Latitude -	35° 36′ N.	-	Secant	0.08986
Declin. -	18 56 N.	-	Sine	9.51117
True amp. W.	23 31 N.	-	Sine	9.60103
Mag. amp. W.	43 0 N.			
Variation -	19 29 or 1¾ point West.			

The courses being corrected for variation and leeway, with their corresponding distances, together with the set and drift of the current, will be as in the Traverse Table.

Courses.	Dist	N.	S.	E.	W.
N. by E. ¼ E.	50	48.5		12.2	
N. ¾ W.	23	22.7			3.4
N. ¼ E.	24	24.0		1.2	
S. S. W. ¼ W.	24		21.7		10.3
		95.2	21.7	13.4	13.7
		21.7			13.4
	Diff. lat.	73.5		Dep	0.3

On summing up the columns of the Traverse Table, it appears that the Ship has sailed due North: hence her distance made good is 73 miles, the same as the difference of latitude; and her longitude is the same as yesterday.

The difference of latitude 73 miles, or 1° 13′ N., added to the latitude left, 35° 2′ N., gives the latitude in, 36° 15′ N.

EXAMPLE III.

Yesterday, at noon, we were in latitude 38° 20′ S., and longitude 10° 34′ E.; at 5 o'clock in the afternoon, the Sun's bearing by Compass was observed to be N. 75° 10′ W., his corrected altitude being at the same time 22° 15′, and declination 18° 47′ S.; and we have sailed till this day at noon, as per log: required the course and distance made good, the latitude and longitude in, and the course and distance to the Cape of Good Hope.

H.	K.	F.	Courses.	Winds.	Leeway.	Remarks.
1	6		E S. E.	N. N. E.		The first and latter part of these 24 hours a moderate breeze and cloudy; the middle light airs and calms, attended with rain.
2	5	4				
3	6					
4	4					
5	1	6				
6	0	6				
7	Calm					
8						
9						
10	1		S. E.	Variable.		
11	3					
12	3		E. S. E.	S. by W.		
1	3					
2	4					
3	5	4				
4	5	4				
5	5					
6	5					
7	5		- -	South.	½	In 1st reefs of the topsails.
8	4					
9	4	6				
10	5	6				
11	4					
12	4	4				

Supposing the variation of the Compass at last observation to have been about 2 points westerly, the Ship has sailed nearly due East from noon to 5 P. M.; consequently the latitude at that time may be considered the same as at noon. Now, with the latitude 38° 20′ S., the altitude 22° 15′, and the declination 18° 47′ S., the true azimuth is found to be N. 96° 54′ W. which, compared with the magnetic azimuth N. 75° 10′ W., gives the variation 21° 44′ W.

Courses.	Dist	N.	S.	E.	W.
S. 89° E.	55		1.0	55.0	
S. 67 E.	4		1.6	3.7	
N. 85 E.	28	2.4		27.9	
		2.4	2.6	86.6	Dep
			2.4		
	Diff. lat.		0.2		

The several courses, corrected for variation to the nearest degree, and for leeway after 7 o'clock A. M., with their corresponding distances, will be as in the Traverse Table; but it is to be observed, that as the distance run from noon to 6 P. M., and from 11 P. M. to 6 A. M., are on the same corrected course, this course, with the sum of the corresponding distances, are entered in the Traverse Table as a single course and distance.

By the Traverse Table, it appears that the Ship has sailed due East: hence her departure is equal to the distance run, and the latitude to-day is the same as that of yesterday. The difference of longitude is found by Parallel Sailing, as follows:—

The co. latitude 51° 40′ as a course, and the departure 86.6 in a dep. column, give the diff. of longitude 110 in a distance column.

The diff. of longitude 110, or 1° 50′ E. added to the longitude of yesterday 10° 34′ E., gives the longitude of the Ship to-day 12° 24′ E.

To find the Bearing and Distance of the Cape of Good Hope.

Lat. of C. of G. Hope	34° 24′ S.	-	Mer. Parts	2200	Long. of C. of G. Hope	18° 32′ E.
Latitude of Ship	- 38 20 S.	-	Mer. Parts	2494	Longitude of Ship	- 12 24 E.
Diff. of latitude	- 3 56=236		Mer. diff. lat.	294	Diff. of longitude	- 6 8=368

Hence the bearing of the Cape of Good Hope is N. 51° E., and the distance 378 miles. The course by Compass is therefore N. 73° E., or E. N. E. ½ E nearly.

EXAMPLE IV.

Yesterday, at noon, we were in latitude 6° 38′ N., and longitude 26° 10′ W.; at 7 o'clock this morning we observed the distance of the Sun and Moon, which gave our longitude at that time 26° 58′ W.; and, by double altitudes, we were in latitude 7° 47′ N. at half past 10, A. M.: required the course and distance made good by the log,—the latitude and longitude at noon by dead reckoning, and the same by the observations.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks.
1	6		N. W. by N.	N. E.		A pleasant breeze with fair weather throughout.
2	6					
3	5					
4	5					
5	5	4				
6	5	4				
7	5					
8	5					
9	5		- -	N. E. by E.		
10	5					
11	4	6				
12	4	4				
1	5					
2	5	2				
3	5					
4	5					
5	5					
6	5					
7	5	2				
8	5	4				
9	6	4				
10	6					
11	6	2				
12	6					Variation per azimuth 8° W.

The variation 8° W. being allowed to the left of N. W. by N., gives the corrected course N. 42° W.; and the knots and fathoms summed up, give the distance run by the log in 24 hours, 128 miles: hence the difference of latitude is 95.1, and the departure 85.6 miles.

Latitude left -	6° 38′ N.		Latitude left -	6° 38′ N.
Diff. of latitude 95′, or	1 35 N.		Latitude in -	8 13 N.
Latitude in by account	8 13 N.		Sum - -	14 51
			Middle latitude	7 25
			Com. of mid. lat.	82 35

The com. of middle latitude 82° 35′, and the departure 85.6, give the difference of longitude 86 miles, or 1° 26′; which, added to the longitude of yesterday, 26° 10′ W., gives the longitude in, by account, 27° 36′ W.

To reduce the Observations to Noon.

The course N. 42° W., and the distance run from half past 10, A. M., till noon, viz. 9 miles, give the diff. of latitude 7′ N.; which added to the latitude by observation 7° 47′ N., their sum, 7° 54′, is the latitude by observation reduced to noon.

The course N. 42° W., and the distance run since 7 o'clock in the morning, 30 miles give the departure made in that interval 20.1, and the diff. of latitude 22.3.

Lat. by observation at noon -	7° 54′ N.		Lat. at noon -	7° 54′ N.
Diff. of lat. from 7 A. M. to noon —	22 N.		Lat. at 7 A. M	7 32 N
Lat. by obs. at 7 A. M. -	7 32 N.		Sum - -	15 26
			Middle latitude	7 43
			Com. of mid. lat.	82 17

The com. of middle latitude 82° 17′, and the departure 20.1, give the diff. of longitude made from 7 A. M. to noon, 20′ W.; which added to 26° 58′ W., the longitude by the observation, their sum, 27° 18′ W., will be the long. by observation brought on to noon.

JOURNAL OF A VOYAGE

FROM

ENGLAND TO MADEIRA,

IN THE SHIP

BRITANNIA,

J. W. N. COMMANDER,

KEPT BY

G. W. MATE

1824.

Days of Month.	Winds.	Remarks on board the Ship BRITANNIA, 1824.
Sunday, June 6.	S. S. W. S. W.	Moderate and clear. At 6 A. M. the Pilot came on board. At 8 A. M. cast loose from the sheer hulk at Deptford, and made sail down the river. At 2 P. M. anchored in Long Reach, and moored Ship with a cable each way.
Monday, June 7.	W. by S.	Fresh gales with showers. P. M. received on board the Carpenter's and Boatswain's stores.
Tuesday, June 8.	S. S. W. to N. N. W.	Light airs and fine weather. At 6 A. M. unmoored and hove short on the best bower. At noon weighed with a light breeze from the westward. At 3 P. M. came to with the best bower off Gravesend.
Wednesday, June 9.	W. N. W.	Moderate weather and fair. At day-light weighed and made sail. At 1 P. M. anchored with the best bower at the Nore, in 9 fathoms. At 5 P. M. weighed and sailed through the Queen's Channel. At ½ past 8 P. M. came to with the best bower at the back of Margate Sand.
Thursday, June 10.	N. by E. N.	Moderate wind and cloudy with showers. At 6 A. M. weighed and made sail. At 8 A. M. run through the Gull-Stream, and came to an anchor in the Downs in 7 fathoms, about 1 mile off shore, Deal Castle bearing W. N. W., the South Foreland S. W., and the North Foreland N. N. E. P. M. the Pilot left the Ship.
Friday, June 11.	N. N. E.	A pleasant breeze with fair weather throughout. A. M. employed filling up the water, stowing the booms and boats, and getting all clear for Sea. At 10 A. M. weighed and made sail. At noon the South Foreland lights bore N. N. W., distant about 4 miles. This log contains 12 hours, and ends at noon, to commence the Sea log.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Saturday, June 12, 1824.
1	1	2	W. S. W. ½ W.	N. N. E.		Light winds and clear.
2	1	4				People employed variously under the Boatswain.
3	2					
4	3					Carpenter making a spare top-gallant yard.
5	3	2				
6	3	4				
7	3					
8	3	4				
9	2	4	W. ¼ N.			
10	2	4	-	- -	-	Dungeness light North.
11	3					
12	3					
1	3	4				
2	4					
3	4	2				
4	4	2	- -	- -	-	Beachy Head W. N. W
5	4	4				
6	5		- -	- -	-	In 1 reef of the topsails
7	5	2				
8	6	2				
9	7		W. N. W. ¼ W.	N. E.	-	Brisk gales.
10	7	4				
11	8					
12	8	4	- -	- -	-	Bembridge Point N. N. W. ¼ W.

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Sunday, June 13, 1824.
1	8		W. N. W.	N. E. by N.		Fresh breezes and fair throughout.
2	8					At ½ past 1 abreast of St. Catherine's Point off shore about 3 miles.
3	8					
4	7	6				
5	7	2	- -	- -	-	St. Aldan's Head N. W. ¼ W.
6	7		West.			
7	7					
8	6	4				
9	6		- -	- -	-	Portland lights N N. W
10	6					
11	6					
12	6		- -	E. N. E.		
1	5					
2	5					
3	5	4				
4	5					
5	5					
6	5					
7	6		N. W. by W.			
8	6	2	- -	- -	-	Two strange sail in sight on the weather bow
9	6					
10	6					
11	5		W. by N.			
12	5					At noon mustered the Ship's company.

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way	Remarks, Monday, June 14, 1824.
1	5		W. by N.	E. N. E.		A brisk wind and clear.
2	5	4				
3	6					
4	6					
5	5	2				
6	4		- -	- -	-	At 6 P. M. the Lizard bore N. E. by N. distant 3 leagues; from which I take my departure.
7	4					
8	3	4				
9	3	6				
10	3					
11	3		- -	N. by W.		
12	3	6				
1	4					
2	4	4	S. W. ½ W.			
3	5					
4	5					A. M. stowed the anchors, unbent the cables, and coiled them down in the tier.
5	5					
6	4	4				
7	4	6				
8	5					
9	5					
10	6					At noon sounded. Ground 76 fathoms; sand, shells, and hakes's teeth.
11	5					
12	5	2				Variation 2¼ points West.

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon.
S. 37° W.	81	65 S.	49 W.	48° 53′ N.		76 W.	6° 27′ W.		

As the Lizard is the last point of land in sight, the Ship's departure is taken from thence, supposing it to be in latitude 49° 58′ N. and longitude 5° 11′ W.; now, as the bearing of the Lizard from the Ship was N. E. by N., the bearing of the Ship from the Lizard was S. W. by S.; but as this is the bearing by Compass, the variation 2¼ points W. is to be allowed to the left-hand, which will give the true bearing S. ¾ W.; this is to be entered in the Traverse Table as a course, and 3 leagues or 9 miles, the supposed distance of the Lizard from the Ship, as a distance run. The courses, corrected for variation, and the distance run by the log, after 6 P. M., are also to be set down in the Traverse Table, as follows.

Courses.	Dist	N.	S.	E.	W.
S. ¾ W.	9		8.9		1.3
W. S.W. ¾ W.	25		6.1		24.3
S. S. W. ¼ W.	55		49.7		23.5
	Diff. lat.		64.7	Dep	49.1

The diff. of lat. 64.7 S. and departure 49.1 W. give the course made good from the Lizard S. 37° W., and the distance 81 miles.

Lat. of the Lizard - -	49° 58′	N.
Diff. of lat. 65m. or - -	1 5	S.
Latitude in - - -	48 53	N.
Sum of latitudes - -	98 51	
Middle latitude - -	49 25	
Comp. of mid. latitude -	40 35	

The comp. of mid. lat. 40° 35′ as a course, and the departure 49.1 in a departure column, give the diff. of longitude in a distance column 76 miles, or - - 1° 16′ W.

Longitude of the Lizard - -	5 11	W.
Longitude in - - - -	6 27	W.

The course and distance made good, the whole diff. of lat. and departure, the lat. and long. in by account, &c. are now to be set down in their respective columns, as above.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Tuesday, June 15, 1824.
1	5	4	S. W.	N. by W.		A moderate breeze with fair weather for the most part.
2	5					
3	5					
4	4	4		N.W. by N.		
5	4					
6	4		W. by S.	- -	½	
7	4					
8	3	6	- -	- -		In 1st reef of the topsails.
9	3	2				
10	3		- -	- -	-	Tacked Ship.
11	3		N. W. by W.	S.W. by W.	1	
12	3					
1	2					
2	2					
3	3					
4	4		- -	- -	-	Out reefs of the topsails.
5	4		- -	- -	-	Tacked.
6	4	4	S by E.	- -	½	
7	4	4				
8	5					
9	5		- -	- -	-	Tacked.
10	5		West.	S. S. W.	¼	Spoke a Brig, bound to Newfoundland.
11	5					
12	5					Variation 2¼ points West.

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon.
S. 42° W.	64	47 S.	42 W.	48° 6′ N.		64 W.	7° 31′ W.		Cape Finisterre, S. 13½° W., 319m.

The courses corrected for variation and leeway, with their corresponding distances, will be as in the following Traverse Table.

Courses.	Dist	N.	S.	E.	W.
S. by W. ¾ W.	24		22.6		8.1
S. W. ¼ W.	18		12.1		13.3
W. N. W. ¼ W.	21	7.1			19.8
S. E. ¼ S.	19		14.1	12.8	
W. S. W.	15		5.7		13.9
		7.1	54.5	12.8	55.1
			7.1		12.8
	Diff. lat.		47.4	Dep	42.3

With the diff. of latitude 47.4 S. and the dep. 42.3 W., the course is found to be S. 42° W., and the distance 64 miles.

Yesterday's latitude	-	48° 53′ N.
Diff. of latitude	- -	47 S.
Latitude in	- - -	48 6 N
Sum of latitudes	- -	96 59
Middle latitude	- -	48 29
Comp. of mid. latitude	-	41 31

With the comp. of mid. latitude 41° 31′, and departure 42.3, the diff. of longitude is found to be 64 miles, or - - - 1° 4′ W.

Yesterday's longitude	-	6 27 W.
Longitude in	- -	7 31 W.

To find the Bearing and Distance of Cape Finisterre.

Latitude of Ship	48° 6′ N. -	Mer. Parts	3301	Longitude of Ship	7° 31′ W.
Lat. of C. Finisterre	42 56 N. -	Mer. Parts	2858	Long. of C. Finisterre	9 17 W.
Diff. of Latitude	5 10=310	Mer. diff. lat.	443	Diff. of Longitude	1 46=106

The mer. diff. lat. 443, and diff. of long. 106, give the course S. 13½° W.; which course, and the proper diff. of latitude 310, give the distance 319 miles.

Ship BRITANNIA from England towards Madeira.

H.	K.	F.	Courses.	Winds.	Lee-way	Remarks, Wednesday, June 16, 1824.
1	5		West.	S. S. W.	¼	The first part a fresh breeze and cloudy; the middle and latter, less wind with a heavy swell from the S. W., for which I allow 12 miles.
2	5					
3	4	6				
4	4	4				
5	4	4				
6	4	2				People employed pointing a new main-sail, and drawing and knotting yarns.
7	4					
8	4					
9	4					
10	4					
11	3	6	- -	- -	½	
12	3	6				
1	3	4				
2	3					
3	3					
4	3					
5	2		W. S. W.	South.	1	
6	2					
7	2	2				
8	2	4	- -	- -	-	Pumped Ship at 14 inches water.
9	2	6				
10	2	4				Lat. obs. by mer. alt. 47° 43′ N.
11	3					
12	3					Variation 2 points West.

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon.
S. 74° W.	75	21 S.	72 W.	47° 45′ N.	47° 43′ N.	108 W.	9° 19′ W.		Cape Finisterre, South, 287 m.

This day the swell setting from the S. W. is supposed to drive the Ship 12 miles to the N. E., which, corrected for variation, is N. N. E.; these are therefore set down as the last course and distance in the Traverse Table.

Courses.	Dist	N.	S.	E.	W.
W. S.W. ¼ W.	44		14.8		41.4
W. S.W. ½ W.	20		5.8		19.1
S. W. by W.	20		11.1		16.6
N. N. E.	12	11.1		4.6	
		11.1	31.7	4.6	77.1
			11.1		4.6
		Diff. lat.	20.6	Dep	72.5

With the diff. of lat. 20.6, and the departure 72.5, the course is S. 74° W., and the distance 75 miles.

Yesterday's latitude -	48°	6′	N.
Diff. of latitude - -		21	S.
Latitude in - - -	47	45	N.
Sum of latitudes - -	95	51	
Middle latitude - -	47	55	
Comp. of mid. latitude -	42	5	

The comp. of mid. latitude 42° 5′, and the departure 72.5, give the difference of longitude 108 miles, or - - - 1° 48′ W.

Yesterday's longitude -	7	31	W.
Longitude in - -	9	19	W.

To find the Bearing and Distance of Cape Finisterre.

Latitude of Ship	47° 43′ N.	- Mer. Parts	3266	Longitude of Ship	9° 19′ W.
Lat. of C. Finisterre	42 56 N.	- Mer. Parts	2858	Long. of C. Finisterre	9 17 W.
Diff. of latitude	4 47=287	Mer. diff. lat.	408	Diff. of longitude -	2

Hence the course is due South, and the distance 287 miles.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Thursday, June 17, 1824.
1	3		West.	S. S. W.	1	
2	3					Mostly fresh breezes throughout, with clou-
3	3	2				dy weather, and rain at times.
4	3	2	- -	- -	-	In 1st reef of the topsails.
5	4					
6	4					
7	4	4	- -	- -	-	Tacked ship
8	5		S. S. E.	S. W.	¼	
9	5					
10	5					
11	5		S. by E.	S.W. by W.		
12	5	2	-	- -	-	At 12 the foot rope of the mizen topsail
1	5	4				gave way; unbent it, and bent another
2	5	2				
3	5					
4	5	4	S. by W.	W. by S.		
5	5	6				
6	6					
7	6					
8	6	4				
9	7					
10	7	2				Lat. obs. by double alts. 46° 3′ N.
11	6					
12	6					Variation 2 points West.

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon.
S. 7° E.	92	92 S.	12 E.	46° 11′ N.	46° 3′ N.	18 E.	9° 1′ W.		Cape Finisterre, S. ¼ W., 187m.

Courses.	Dist	N.	S.	E.	W.
W. by S.	25		4.9		24.5
S. E. ¼ E.	15		10.1	11.1	
S. E. by S.	26		21.6	14.4	
S. by E.	56		54.9	10.9	
	Diff. lat.		91.5	36.4	24.5
				24.5	
			Dep	11.9	

The diff. of latitude 91.5, and dep. 11.9, give the course S. 7° E, and the distance 92 miles.

Yesterday's lat. by obs. -	47° 43′	N.
Diff. of lat. 92m. or - -	1 32	S.
Lat. in by account - -	46 11	N.

The latitude by account differing considerably from the latitude by observation, and as the course is near the meridian, I conclude that the error in the reckoning arises from the distance, and therefore find the difference of longitude by Case I., page 289.

Yest. lat. by obs.	47° 43′ N.	Mer. Pts. 3266
Lat. to-day by obs.	46 3 N.	Mer. Pts. 3120
Mer. diff. lat. by observation -		146

The course 7°, and the mer. diff. lat. by obs. 146, give the diff. of long. 0° 18′ E.

Long. yesterday -	9 19 W.
Longitude in -	9 1 W.

To find the Bearing and Distance of Cape Finisterre.

Latitude of Ship	46° 3′ N. -	Mer. Parts 3120	Longitude of Ship	9° 1′ W.
Lat. of C. Finisterre	42 56 N. -	Mer. Parts 2858	Long. of C. Finisterre	9 17 W
Diff. of latitude	3 7=187	Mer. diff. lat. 262	Diff. of longitude -	0 16

Hence the true course is about S. ¼ W., or the magnetic course S S. W. ¼ W , and the distance 187 miles.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Friday, June 18, 1824.
1	6		S. by W.	W. by S.		Fresh breezes throughout, with fair weather and smooth water.
2	7					
3	7					People employed under the Boatswain.—Carpenter making a top-mast studding-sail boom.
4	6	6				
5	6					
6	6		S. by E.	S.W. by W.		Sailmaker making a quarter-deck awning.
7	6					
8	6					
9	6					
10	6	4	- -	- -	-	Tacked.
11	6	6	West.	S. S. W.		
12	7					
1	7					
2	7					
3	7	4				
4	8					
5	8					
6	8					
7	8		- -	- -	-	Passed by a Ship under American colours standing to the Eastward.
8	8					
9	7	2				
10	7	4				Lat. obs. by mer. alt. 44° 19′ N.
11	7					
12	7					Variation 2 points West.

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon.
S. 33° W.	124	104 S.	67.9 W.	44° 26′ N.	44° 19′ N.	96 W	10° 37′ W.		Cape Finisterre, S. E. by S., 101m.

Courses.	Dist	N.	S.	E.	W.
S. by E.	33		32.4	6.4	
S. E. by S.	30		24.9	16.7	
W. S. W.	104		39.8		96.1
	Diff. lat.		97.1	23.1	96.1
					23.1
				Dep	73.0

The diff. of lat. 97.1, and the dep. 73.0, give the course S. 37° W., and distance 122 miles.

Yesterday's lat. by obs. - 46° 3′ N.
Diff. of lat. 97m. or - - 1 37 S.
Latitude in by acc. - - 44 26 N.

Yesterday's lat. by obs. 46° 3′ N. Mer. Pts. 3120
Latitude in by obs. - 44 19 N. Mer. Pts. 2972
Diff. lat. by obs. 104 = 1 44 Mer. diff. lat. 148

The latitude by observation not agreeing with the latitude by account, I correct the dead reckoning by Case III., page 290; because, the course being near 4 points, it is presumed that the course and distance are both erroneous.

The distance by account 122, and the diff. of lat. by observation 104, give in a departure column 62.8; which added to the departure by account 73, half their sum 67.9 is the true departure.

The departure 67.9, and diff. of latitude by obs. 104, give the true course S. 33° W., and distance 124 miles. The course 33°, and the mer. diff. of latitude between the observations 148, give the true diff. of longitude 96 miles, or 1° 36′ W.
Longitude yesterday - - 9 1 W.
Longitude in - - - - 10 37 W.

To find the Bearing and Distance of Cape Finisterre.

Latitude of Ship 44° 19′ N. - Mer. Parts 2972 Longitude of Ship 10° 37′ W.
Lat. of C. Finisterre 42 56 N. - Mer. Parts 2858 Long. of C. Finisterre 9 17 W.
Diff. of latitude 1 23=83 Mer. diff. lat. 114 Diff. of longitude - 1 20=80

Hence the bearing of Cape Finisterre is S. E. by S., or S. by E. by compass, and the distance 101 miles.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Saturday, June 19, 1824.
1	6	6	W. by S.	S. by W.		Strong breezes, with rain, attended with hard squalls, thunder, and lightning.
2	6	2				
3	6					In 1st reef of the topsails.
4	5					
5	5		- -	- -	-	Tacked.
6	5		S. E. by S.	S. W. by S.	1	Squally. In top-gallant sails.
7	5		- -	- -	-	In 2d reef of the top-sails.
8	4	-	- -	- -	-	Down top-gallant yards.
9	4		S. S. E.	S. W.	1	
10	4		- -	- -	-	Hard squalls. Handed the main-sail and mizen top-sail.
11	3	6				
12	3		- -	- -	-	Close reefed, and handed the fore and main top-sails, and brought the Ship to under a fore sail, mizen, and main stay-sail.
1	-		up S. by E.		5	
2	-		off SE. by E			
3	-		up W. by S.	Variable.	-	Wore Ship.
4	-		off NWb.W		5	
5	3		W. by N.	S. W. by S.	1½	At day-light more moderate. Set the top-sails double reefed, and the main-sail. Up top-gallant yards.
6	3					
7	4		- -	- -		
8	4	6	West.	S. S. W.	1½	Fair weather. Out all reefs of the top-sails. Set the top-gallant sails.
9	4	2				
10	4					
11	4					
12	4					Variation 2 points West.

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon.
S. W.	41	29 S.	29 W.	43° 50 N.		40 W.	11° 17′ W.		Cape Finisterre, S. E. by E. ¼ E. 102m.

It appears by the log of this day, that the Ship has been lying-to from midnight to 4 in the morning; therefore the middle points between those the Ship comes up to and falls off to, corrected for variation and leeway, as directed in page 287. together with the drift, which is here assumed at 1 knot per hour, are inserted in the Traverse Table as the fourth and fifth course and distance.

Courses.	Dist	N.	S.	E.	W.
S. W. by W.	29		16.1		24.1
E. S. E.	14		5.4	12.9	
S. E. by E.	15		8.3	12.5	
E. N. E.	2	0.8		1.8	
N. W.	2	1.4			1.4
W. ½ N.	10	1.0			10.0
W. ½ S.	21		2.1		20.9
		3.2	31.9	27.2	56.4
			3.2		27.2
	Diff. lat.		28.7	Dep	29.2

The diff. of lat. 28.7 and dep. 29.2, give the course S. 45½° W., and distance 41 miles.

Yesterday's lat. 44° 19′ N. Mer. Pts. 2972
Diff. lat. - - 29 S.

Latitude in - 43 50 N. Mer. Pts. 2932
Sum of latitudes 88 9
Mid. latitude - 44 4 Mer. diff. lat. 40
Co. mid. latitude 45 56

The comp. of mid. lat. 45° 56, and dep. 29.2, or the course 45½°, and the mer. diff. of lat. 40, give the diff. of long. - 0° 40′ W.
Yesterday's longitude - 10 37 W.

Longitude in - - 11 17 W

To find the Bearing and Distance of Cape Finisterre.

Latitude of Ship 43° 50′ N. - Mer. Parts 2932 Longitude of Ship 11° 17 W
Lat. of C. Finisterre 42 56 N. - Mer. Parts 2858 Long. of C. Finisterre 9 17 W.

Diff. of latitude - 54 Mer. diff. lat. 74 Diff. of longitude - 2 0=120

Hence the true bearing of Cape Finisterre is S. E. by E.¼E. S.E.by S.¼E. by compass and the distance 102 miles.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Sunday, June 20, 1824.
1	4		West.	S. S. W.	1¼	Fair weather throughout.
2	4					
3	4					
4	4					
5	4					
6	4	6	W. by S.	S. by W.	1	
7	5					
8	5	2				
9	5		S. W. by W.	S. by E.	½	
10	5					
11	5					
12	5					
1	5					
2	5					
3	5	4				
4	5	6	S. W.	S. E. by S.		
5	5					
6	5					
7	4	4				
8	4					
9	4	2				At noon pumped Ship at 10 inches water.
10	4					
11	4	4				
12	4					Variation per amplitude 21° West.

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon.
S. 46° W.	102	72 S.	74 W.	42° 38′ N.		103 W.	13° 0′ W.		Porto Santo, S. 15 ° W., 596 m.

The variation, as observed by an amplitude, being 21° W., the courses are corrected to the nearest degree before they are inserted in the Traverse Table.

Courses.	Dist	N.	S.	E.	W.
S. 83° W.	20		2.4		19.9
S. 69 W.	15		5.4		14.0
S. 41 W.	35		26.4		23.0
S. 24 W.	41		37.5		16.7
	Diff. lat.		71.7	Dep	73.6

The diff. of latitude 71.7, and dep. 73.6, give the course S. 46° W., and distance 102 miles.

Yesterday's lat. 43° 50′ N. Mer. Parts 2932
Diff. of lat. 72, or 1 12 S.
Latitude in - 42 38 N. Mer. Parts 2833
Mer. diff. lat. 99

The course 46°, and the mer. diff. of latitude 99, give the difference of longitude 103 miles, or - - - - 1° 43′ W.
Yesterday's longitude - 11 17 W.
Longitude in - - 13 0 W.

To find the Bearing and Distance of Porto Santo

Latitude of Ship 42° 38′ N. - Mer. Parts 2833 Longitude of Ship 13° 0′ W.
Lat. of Porto Santo 33 3 N. - Mer. Parts 2103 Long. of Porto Santo 16 17 W.
Diff. of latitude - 9 35=575 Mer. diff. lat. 730 Diff. of longitude - 3 17=197

The mer. diff. lat. 730, and the diff. of long. 197, give the true course S. 15 ° W.; this course, and the proper diff. of lat. 575, give the distance 596 miles. The course to be steered is therefore S. 36 ° W., or S. W. ¾ S.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Leeway.	Remarks, Monday, June 21, 1824.
1	4		S. W	S. E.	-	Variable light breezes and calms, with hot sultry weather.
2	4					
3	3	6				People and tradesmen employed variously.
4	3	2				
5	3					
6	2	4				
7	2	4	- -	Variable.		
8	3					
9	2					
10	2					
11	2					
12	1					
1						
2						
3		-	- -	Calm.	-	
4						
5		-	- -	- -		Tried the current, and found it setting N. E. by N. at the rate of ½ a mile per hour.
6						
7	1		S. W. by S.	N. E. by E.		
8	1	6				
9	2					
10	2	4	- -	E. by N.		Lat. obs. by mer. alt. 42° 3′ N.
11	3					
12	3	6				Variation per azimuth 20° 19′ W.

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon.
S. 24° W.	35	32 S.	14 W.	42° 6′ N.	42° 3′ N.	19 W.	13° 19′ W.		Porto Santo, S. 15° W., 558m.

By this day's log it appears that the current set N. E. by N. by compass, which, corrected for variation, is N. 13° E.; and the drift was at the rate of half a mile per hour, making 12 miles in the 24 hours; these are therefore set down in the Traverse Table as a course and distance.

Courses.	Dist	N.	S.	E.	W.
S. 25° W.	33		29.9		13.9
S. 13 W.	14		13.6		3.1
N. 13 E.	12	11.7		2.7	
		11.7	43.5	2.7	17.0
			11.7		2.7
	Diff. lat.		31.8	Dep	14.3

The diff. of lat. 31.8, and dep. 14.3, give the course S. 24° W., and distance 35 miles.

Yesterday's lat. 42° 38′ N. Mer. Parts 2833
Diff. of latitude 32 S.

Latitude in - 42 6 N. Mer. Parts 2790
Sum of lats. - 84 44
Middle lat. - 42 22 Mer. diff. lat. 43
Comp. mid. lat. 47 38

The comp. of mid. lat. 47° 38′, and the departure 14.3, or the course 24°, and the mer. diff of lat. 43, give the diff. of longitude - 0° 19′ W.
Yesterday's longitude - 13 0 W.

Longitude in - - 13 19 W.

To find the Bearing and Distance of Porto Santo.

Latitude of Ship 42° 3′ N. - Mer. Parts 2786 Longitude of Ship 13° 19′ W
Lat. of Porto Santo 33 3 N. - Mer. Parts 2103 Long. of Porto Santo 16 17 W.

Diff. of latitude - 9 0=540 Mer. diff. lat. 683 Diff. of longitude - 2 58=178

The mer. diff. of lat. 683, and diff. of longitude 178, give the true course S. 15° W.: this course, and the proper diff. of lat. 540, give the distance 558 miles. Hence the course by compass is S. 35° W., or S. W. by S. nearly.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Tuesday, June 22, 1824.
1	4		S. S. W. ½ W.	E. by N.		An increasing breeze throughout, with fair weather and smooth water. Employed as yesterday.
2	4	4				
3	5					
4	5					
5	5					
6	5	2				
7	5	6	- -	Variable.		
8	6					
9	6					
10	6	4	- -	S. E.		
11	7					
12	7					
1	7					
2	7					
3	7					
4	8		S. W. by W.	S. by E.		
5	7					At 6h. 41m. A. M. observed the distance between the Sun and Moon, which gives our longitude at noon 13° 55′ West of Greenwich.
6	7	4				
7	7	6	S. W.	S. S. E.		
8	7	2				
9	8					
10	8					Lat. obs. by mer. alt. 39° 36′ N.
11	7	4				
12	7	4				Variation 1¾ point West.

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon.
S. 17° W.	153	146 S.	46 W.	39° 37′ N.	39° 36′ N.	59 W.	14° 18′ W.	13° 55′ W.	Porto Santo, S. by W. ½ W., 409m.

The courses being corrected for variation, with the corresponding distances, will be as in the Traverse Table.

Courses.	Dist	N.	S.	E.	W.
S. ¾ W.	88		87.0		12.9
S. W. ¾ S.	22		17.7		13.1
S. S. W. ¼ W.	46		41.6		19.7
	Diff. lat.		146.3	Dep	45.7

The diff. of lat. 146.3, and departure 45.7, give the course S. 17° W., and the distance 153 miles.

Yesterday's lat.	42° 3′ N.	Mer. Pts.	2736
Diff. of lat. 146, or	2 26 S.		
Latitude in -	39 37 N.	Mer. Pts.	2593
Sum of latitudes	81 40		
Middle latitude	40 50	Mer. diff. lat.	193
Comp. of mid. lat.	49 10		

The comp. of mid. latitude 49° 10′, and the departure 45.7, give the diff. of longitude 61 miles; or the course 17°, and mer. diff. of latitude 193, give the difference of longitude - - - - - 0° 59′ W.

Yesterday's longitude - -	13 19 W.
Longitude in - - -	14 18 W.

To find the Bearing and Distance of Porto Santo.

Latitude of Ship	39° 36′ N. -	Mer. Parts 2591		Longitude of Ship	13° 55′ W.
Lat. of Porto Santo	33 3 N. -	Mer. Parts 2103		Long. of Porto Santo	16 17 W.
Diff. of latitude -	6 33=393	Mer. diff. lat. 488		Diff. of longitude -	2 22=142

Hence the bearing of Porto Santo is S. by W. ½ W., and the distance 409 miles. The course therefore to be steered is S. W. ¾ S.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Wednesday, June 23, 1824.
1	7	4	S. W.	S. S. E.	-	A fresh breeze throughout, with passing squalls, and rain at times.
2	7	6				
3	8					
4	8					People and tradesmen employed as yesterday. Gunner painting the Boats.
5	8					
6	8					
7	8					
8	8					
9	8					
10	8	4	- -	S. E.	-	In 1st reef of the topsails.
11	8	2				
12	8					
1	7	4				
2	7	4	- -	S. E. by S.		
3	7					
4	7					
5	7					
6	8					
7	8					
8	8		S. W. ½ W.	S. by E.		Lat. obs. by mer. alt. 36° 50′ N.
9	8					
10	7	6				
11	7	4				
12	7					Variation per azimuth 18° 42′ W.

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon.
S. 27° W.	186	165 S.	85 W.	36° 51′ N.	36° 50′ N.	107 W.	16° 5′ W.	15° 42′ W.	Porto Santo, S. 7W., 229m.

The courses corrected for variation to the nearest degree, with the corresponding distances, will be as under.

Courses.	Dist	N.	S.	E.	W.
S. 26° W.	148		133.0		64.9
S. 32 W.	38		32.2		20.1
	Diff. lat.		165.2	Dep	85.0

The diff. of latitude 165.2, and the departure 85.0, give the course S. 27° W., and distance 186 miles.

Yesterday's lat.	39°	36′	N.	Mer. Pts.	2591
Diff. of lat. 165, or	2	45	S.		
Latitude in -	36	51	N.	Mer. Pts.	2381
Sum of latitudes	76	27			
Mid. latitude -	38	13		Mer. diff. lat.	210
Co. mid. latitude	51	47			

The comp. of mid. latitude 51° 47′, and the departure 85.0, give the diff. of longitude 108 miles; or, the course 27°, and the mer. diff. of latitude 210, give the diff. of longitude 107 miles.

Yesterday's long. by acc.	14°	18′	W.
Diff. of long. 107 miles, or	1	47	W.
Longitude in by account	16	5	W.

Yesterday's long. by obs.	13°	55′	W.
Diff. of long. 107 miles, or	1	47	W.
Longitude in by observation	15	42	W.

To find the Bearing and Distance of Porto Santo.

Latitude of Ship	36° 50′ N.	-	Mer. Parts 2380	Longitude of Ship	15°	42′	W.
Lat. of Porto Santo	33 3 N.	-	Mer. Parts 2103	Long. of Porto Santo	16	17	W.
Diff. of latitude	3 47=227		Mer. diff. lat. 277	Diff. of longitude	-	35	

Hence the true course to Porto Santo is S. 7° W., or the magnetic course S. S. W. ½ W nearly, and the distance 229 miles.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Thursday, June 24, 1824.
1	7	4	S W.	S. S. E.		First part a fresh breeze, middle and latter more moderate, and smooth water.
2	7					
3	7					
4	7					
5	6	6				
6	6					
7	6					
8	5					
9	5		W. S. W.	South.	½	
10	5					
11	5		- -	- -	-	
12	4	6	S. E. by E.	S. by W.	1	
1	4	6				
2	5					
3	4	4				
4	4					At 3h. 16m. A. M. observed the distance of the Moon's remote limb from the Star α Pegasi, which gives our longitude at noon 16° 23′ West of Greenwich.
5	4					
6	4		S. E. by S.	S. W. by S.	1	
7	4	4				
8	4					
9	3	6	- -	- -	-	Tacked.
10	3	2	West.	S. S. W.	1½	Lat. obs. by mer. alt. 35° 46′ N.
11	3					
12	3					Variation 1½ point West.

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon.
S. 4° W.	65	64 S.	5 W.	35° 46′ N.	35° 46′ N.	6 W.	16° 11′ W.	16° 23′ W.	Porto Santo, South, 163m.

The courses corrected for variation and leeway, with their corresponding distances, will be as under.

Courses.	Dist	N.	S.	E.	W.
S. S. W. ½ W.	52		45.9		24.5
S. W. by W.	15		8.3		12.5
E. ½ S.	27		2.6	26.9	
E S. E. ½ S.	16		7.5	14.1	
West.	9				9.0
	Diff. lat.		64.3	41.0	46.0
					41.0
				Dep	5.0

The diff. of latitude 64.3, and dep. 5.0, give the course S. 4° W., and the distance 65 miles.

Yesterday's lat.	36° 50′ N.	Mer. Parts	2380
Diff. of lat. 64, or	1 4 S.		
Latitude in -	35 46 N.	Mer. Parts	2301
Sum of lats. -	72 36		
Mid. latitude -	36 18	Mer. diff. lat.	79
Co. mid. latitude	53 42		

The comp. of mid. latitude 53° 42′ and the departure 5.0, or the course 4° and the mer. diff. of lat. 79, give the diff. of longitude - 0° 6′ W.
Yesterday's longitude by account - 16 5 W.

Longitude in by account - 16 11 W.

To find the Bearing and Distance of Porto Santo.

Latitude of Ship	35° 46′ N. -	Mer. Parts	2301	Longitude of Ship	16° 23′ W.
Lat. of Porto Santo	33 3 N. -	Mer. Parts	2103	Long. of Porto Santo	16 17 W.
Diff. of latitude -	2 43=163	Mer. diff. lat.	198	Diff. of longitude -	6

Hence the true bearing is South nearly, and the distance 163 miles. The course to be teered is therefore S. by W ½ W.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Friday, June 25, 1824.
1	3		West.	S. S. W.	1½	
2	3					An increasing breeze and fair.
3	4					
4	4	6	S. W. by W.	S. by E.	1	A. M. bent the best bower and sheet cables, and unstowed the anchors. People otherwise employed, reeving the Harbour-Gier, and in sundry small jobs.
5	5					
6	5					
7	5	4				
8	6		South.	East.		
9	6					
10	6					
11	6		S. S. E.			
12	6					
1	6	4	- -	E. N. E.		
2	6	6				
3	6	6				
4	7					
5	7					
6	7					
7	7		- -	N. E. by E.		
8	7					
9	7	4				
10	8					Lat. obs. by mer. alt. 33° 56′ N.
11	8		- -	N. E.		
12	7	4				Variation 1½ point West.

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon
S. 21½° E.	113	106 S.	42 E.	34° 0′ N.	33° 56′ N.	51 E.	15° 20′ W.	15° 32′ W.	Porto Santo, S. 35° W., 65 m.

Courses.	Dist	N.	S.	E.	W.
West.	10				10.0
S. W. ½ W.	20		12.7		15.5
S. by E. ½ E.	18		17.2	5.2	
S. E. ½ S.	98		75.7	62.2	
	Diff. lat.		105.6	67.4	25.5
				25.5	
			Dep.	41.9	

The diff. of lat. 105.6, and departure 41.9, give the course S. 21½° E., and the distance 113 miles.

Yesterday's lat.	35° 46′ N.	Mer. Pts.	2301
Diff. of lat. 106′, or	1 46 S.		
Latitude in -	34 0 N.	Mer. Pts.	2171
Sum of latitudes	69 46		
Middle latitude	34 53	Mer. diff. lat.	130
Co. mid. latitude	55 7		

The comp. of mid. latitude 55° 7′ and the departure 41.9, or the course 21½° and the mer. diff. of lat. 130, give the diff. of longitude 51 miles.

Yesterday's long. by acc.	16° 11′ W.	Yesterday's long. by obs.	16° 23′ W.
Diff. of longitude -	51 E.	Diff. of longitude -	51 E.
Longitude in by account	15 20 W.	Longitude in by observation	15 32 W.

To find the Bearing and Distance of Porto Santo.

Latitude of Ship	33° 56′ N. -	Mer. Parts	2167	Longitude of Ship	15° 32′ W.
Lat. of Porto Santo	33 3 N. -	Mer. Parts	2103	Long. of Porto Santo	16 17 W.
Diff. of latitude -	53	Mer. diff. lat.	64	Diff. of longitude -	45

Hence the true bearing is S. 35° W., and the distance 65 miles. The course to be steered is therefore S. 52° W., or S. W. ¾ W.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Saturday, June 26, 1824.
1	7	2	S. W. by S	N. E.		A pleasant breeze and fair throughout.
2	7					A. M. bent the small bower cable, and unstowed the anchor
3	6	4				
4	6					
5	5	4	S. W. by W.	E. N. E.		
6	5		- -	- -	-	Saw the land bearing S. W. by S.
7	5	2				
8	5					
9	5	2		East.	-	Porto Santo W. S. W. about 5 leagues.
10						At 10 P. M. brought-to. Main top-sail to the mast.
11						
12		-	Lying-to.			
1						
2						
3			W. S. W.	- -	-	At day-light made sail.
4						
5						
6		-	- -	- -	-	Porto Santo N. W. by N. Deserters S. W. by S. East end of Madeira W. by S.
7						
8						At noon came to an anchor in Funchal Roads, with the best bower, in 25 fathoms; mud and sand; off shore ¼ of a mile; Loo Castle bearing N. N. W., and Fort Lorenzo E. N. E.
9			W. by S.			
10			Various.			
11						
12						

Course.	Dist.	Diff. lat.	Dep.	Lat. acc.	Lat. obs.	Diff. long.	Long. acc.	Long. obs.	Bearing and Distance at noon.

The courses steered from noon to 9 P. M., and the bearing of Porto Santo from the Ship at that time, corrected for 1½ point West variation; also the distances run, and the estimated distance of the Ship from the land, being entered in a Traverse Table, will give the diff. of latitude 55.4, and the departure 35.9.

From hence the latitude of Porto Santo, by the Ship's reckoning, is found to be 33° 1′ N., and the longitude, carried on from the last lunar observation, 16° 15′ W.; differing 2 miles in latitude, and 2 miles in longitude, from its position, as laid down in Table XLII.

The Ship's track, during the preceding Voyage, is laid down on the Mercator's Chart, according to the latitude and longitude each day at noon.

ABSTRACT OF THE PRECEDING JOURNAL.

Week Days.	Month Day.	Winds.	Courses.	Dist.	Lat. by acc.	Lat. by obs.	Long. by acc.	Long. by obs.	Bearings and Distances at Noon.
Monday . . .	1824 June 14	E. N. E. N. by W.	S. 37° W.	81	48° 53′ N.		6° 27′ W.		
Tuesday . . .	15	N. by W. S. S. W.	S. 42° W.	64	48 6		7 31		C. Finisterre, S. 13½° W., 319 miles.
Wednesday .	16	S. S. W. S.	S. 74° W.	75	47 45	47° 43′ N.	9 19		C. Finisterre, South, 287 miles.
Thursday . .	17	S. S. W. W. by S.	S. 7° E.	92	46 11	46 3	9 1		C. Finisterre, S. ¼ W., 187 miles.
Friday	18	W. by S. S. S. W.	S. 33° W.	124	44 26	44 19	10 37		C. Finisterre, S. E. by S., 101 miles.
Saturday . . .	19	Variable.	S. W.	41	43 50		11 17		C. Finisterre, S. E. by E. ¼ E. 102 miles.
Sunday	20	S. S. W. S. E. by S.	S. 46° W.	102	42 38		13 0		Porto Santo, S. 15 ° W., 596 miles.
Monday . . .	21	Variable.	S. 24° W.	35	42 6	42 3	13 19		Porto Santo, S. 15° W., 558 miles.
Tuesday . . .	22	Variable.	S. 17° W.	153	39 37	39 36	14 18	13° 55′ W.	Porto Santo, S. by W. ½ W., 409 miles.
Wednesday .	23	S. E.	S. 27° W.	186	36 51	36 50	16 5	15 42	Porto Santo, S. 7° W., 229 miles.
Thursday . .	24	S. S. E. S. S. W.	S. 4° W.	65	35 46	35 46	16 11	16 23	Porto Santo, South, 163 miles.
Friday	25	S. S. W. N. Easterly.	S. 21½° E.	113	34 0	33 56	15 20	15 32	Porto Santo, S. 35° W., 65 miles.
Saturday . . .	26	N. E. East.							Anchored in Funchal Roads.

H.	K.	F.	Courses.	Winds.	No. of Signals.	Remarks and Occurrences Wednesday, October 14, 18-4.
1	3	6	S. S. W.	S. S. E. ½ E.		Hazy with rain. A. M.
2	2	6				
3	2	6	S. W.			
4	2	-	- -	- -	-	Light breezes with rain.
5	5	4	W. by S.	S. by W.		
6	5	4	W. S. W.			
7	5	4	W. by S.			
8	3		W. N. W.	S. W.	-	Tacked to southward. Carpenter repairing the Jolly Boat.
9		4	S. S. E.			
10			Calm.			
11	1		W. N. W.	Variable.	-	Unbent Spanker, and bent another. Hauled up Mainsail. At noon hazy weather
12		4	West.			

Course.	Distance.	Latitude in.	Longitude in.	Bearings and Distance.
S. 26° W.	57	53° 38′ N.	2° 23′ E.	Lowestoff, S. 17° W., 72 miles.

1	2		W. N W.	S. W.	-	Light airs and hazy weather. P. M. At 1h. 30m. saw 4 sail to windward.
2	1	4				
3	2		West.	S. S. W.		
4	2	6	W. by S.	S. by W.	-	Sailmaker repairing Mainsail.
5	2	6	W. S. W. ½ W.	South.		
6	2		W. S. W. ½ S.	- -	-	Tacked.
7	2		- -	- -	-	Hauled up the courses and hove to; lowered the Jolly Boat and boarded a Fisherman; at 7h. 30m. up Boat and made sail.
8	1					
9	4		W. by S.			
10	3	6	- -	- -	-	Thick foggy weather.
11	2	4				
12	2	4	- -	- -	-	Ditto at midnight.

The above form is now used in the Navy, in consequence of the following order from the Admiralty. *Admiralty, 11th October, 1805.*

Sir,—I have the commands of the Lords Commissioners of the Admiralty to send you herewith a Form of the Log-book which is intended in future to be kept in all King's Ships; and to signify their direction to you to cause the Log-book of the Ship under your command to be kept according to the said Form, observing that the calendar or civil day is to be made use of, beginning at midnight.—It is their Lordships' further direction, that in future, you send a Log-book instead of a Journal to this Office and to the Navy Board as directed by the General Printed Instructions.—You will observe there will be no necessity for making any alteration in the manner of marking the Log-board; but when it i copied into the book, the part beginning at midnight is to stand first in the page.—It i necessary to remark to you, that the private night Signal for each day of the month is t continue in force until day-light of the following day.

I am, Sir, your very humble servant,

To Captain ———, commanding H. M. Ship ———. J. B.

SHIP ESSEX from ENGLAND towards CEYLON.

H.	Courses.	K.	F.	Winds, &c.	Lee-way.	Friday, August 12, 1803.
1	S. W.	2		S. S. E.	1	Moderate breezes and pleasant weather throughout.
2		2	4			
3		3	2			A. M. stay'd the masts and set up the main and main-top-mast rigging.
4		3	2			
5		3	4			Tradesmen variously employed.
6		4				
7		2	4			
8		3				
9		3				
10		3				
11		3				
12		3				
1		3	6			
2		3	6			
3		2				
4		2	6			
5	W. S. W.	3	6	S. by E.	-	
6		4				
7		3	6			
8		3	6			
9		2				Latitude observed 2° 0′ N.
10		2				
11		2				
12		2				
	Dist. per log.	72m.		11 Inches in the Well.		

Course and dist. S. 50° W. 70m.	X Lat. { obs. 58 acc. 46	X Lon { acc. 54 chr. 82	Lat. { obs 2° 0 N. acc. 2 12 N.	Lon. { mde. in 21 41 } ☾ chr. 20 12 W.	var. { pm. am. 10° W.
Departure 54	S. of acc. 12	W. of acc. 28	Barom. 29.5	Therm. 78°	

H	Courses.	K.	F.	Winds, &c.	Lee-way.	Saturday, August 13, 1803.
1	S. W.	4		S. S. E.	½	A steady breeze and fine weather throughout.
2	W. S. W.	4	4			
3		4				A. M. set up the mizen rigging.
4		4				Washed the gun-deck and exercised great guns and small arms.
5	S. W.	4			½	
6		4				
7		2	6			Longitude per Sun and Moon at 11 A. M., 22° 8′ W. of Greenwich.
8		2	4			
9		2	2			
10		2				
11		2	6			
12		3				
1		3				
2		2	6			
3		3				
4		3				
5		3				
6	W. S. W.	3		South.	½	
7		4	6			
8		4	6			Latitude observed 0° 56′ N.
9		3	6			
10		3	4			A strong set to the westward.
11	S. S. W.	3	4	S. E.	½	
12		3	2			
	Dist. per log.	82m.		10 Inches in the Well.		

Course and dist. S. 47° W. 79m.	X Lat. { obs. 64 acc. 54	X Lon. { acc. 58 chr. 113	Lat. { obs. 0° 56 N. acc. 1 6 N.	Lon. { mde. in 22 39 } ☾ 22° 9 W. chr 22 5	var { pm. am. 10° W.
Departure 58	S. of acc. 10	W. of acc. 55	Barom. 29.6	Therm. 78°	

EXPLANATION OF SEA TERMS.

ABACK. The situation of the sails when their surfaces are pressed aft against the masts by the force of the wind.

Abaft, or *Aft.* The hinder part of a Ship, or all those parts which lie towards the stern; used relatively, it signifies further aft, or nearer the stern.

Aboard, or *Inboard.* The inside of a Ship.

About. The situation of a Ship as soon as she has tacked.

About Ship! The order to the Ship's crew to prepare for tacking.

Abreast. Side by side.

Adrift. The state of a Vessel broken loose from her moorings, and driving about without controul.

Afloat. Buoyed up by the water from the ground.

A-lee. The position of the helm when it is put down to the lee side.

Aloft. Up in the tops, or at the mast-heads, or anywhere in the higher rigging.

Aloof. At a distance.

Apron. A square piece of sheet lead tied over the touch-hole of a cannon to keep the water out.

Athwart. Across; as, " we discovered a fleet steering athwart us;" that is, steering across our way.

Athwart hawse. The situation of a Ship or Vessel when driven by accident across the fore part of another.

Avast! The order to stop or pause in any exercise or operation.

Awning. A canopy of canvass extending over the decks of a Ship, or over a Boat, in hot weather, to protect the officers and crew, and preserve the decks from the heat of the Sun. Also, part of the poop deck which is continued forward beyond the bulk head of the cuddy in East India Ships.

Bale. To bale a boat is to throw the water out of her which has got in by means of a leak, the spray of the sea, or otherwise.

Bare poles. When a Ship at Sea has no sails set, she is then said to be under bare poles.

Ballast. A certain portion of stone, iron, gravel, or any such like materials, deposited in a Ship's hold, when she has no cargo on board, or not sufficient to bring her low enough down in the water, so as to prevent her from upsetting.

Barge. A Vessel or Boat of State: those employed in the Navy are for the use of the Admirals, Captains, and superior Officers. Also, the name of a flat-bottomed Vessel of burthen, used in loading or unloading Ships.

Batten. A long thin piece of wood.

To batten down the hatches. To lay battens upon the tarpaulins which are over the hatches, in bad weather, and nail them down that they may not be washed or blown off.

Beach. The sea shore, or margin of the sea.

Beacon. A post, or stake, erected over a shoal, or sand bank, as a warning to seamen to keep at a distance. Also, a signal placed at the top of hills, &c.

Beams. Strong thick pieces of timber, stretching across the ship from side to side, to support the decks, and retain the sides at their proper distance.

Bearing. The situation of one place from another, with regard to the points of the Compass. The situation, also, of any distant object, estimated from some part of the Ship, according to her situation.

To belay. To fasten any running rope; as, "belay the main brace;" that is, make it fast.

Bend. That part of one rope which is fastened to another, or to an anchor, &c.

To bend. To fasten one rope to another: to bend sails, is to extend and fasten them to the yards.

Bight. The double part of a rope when it is folded, in contradistinction to the two ends. Also, a small inlet of the sea.

Bilge. To break; as, "the Ship is bilged;" that is, her planks are broken in by violence.

Bilge-water. Water which, by reason of the flatness of a Ship's bottom, lies on her floor, and cannot go to the well of the pump.

Binnacle. A wooden case or box, on the deck of a Ship, containing the Compasses by which the Vessel is steered.

Birth. A place; as, "the Ship's birth;" that is, the place where she is moored. It also signifies the place where the Officers, or any of the Ship's company, mess or sleep in.

To birth the Ship's company. To allot to each man the place where he is to mess and hang up his hammock.

Bitts. Very large pieces of timber round which the cables are fastened, when the Ship is at anchor; there are also smaller bitts where the top-sail sheets are made fast to.

Block. A piece of wood with a sheave or wheel in it, through which a rope is put to add to the purchase.

Bluff. Broad; as, "the Ship is bluff bowed;" that is, has broad and flat bows.

Boatswain. The Officer who has the charge of all the cordage, rigging, anchors, &c.

Bolt-rope. A rope to which the edges of a sail are sewed, in order to strengthen them; the side ropes are called *leach ropes,* that at the top the *head rope,* and that at the bottom the *foot rope.*

Bonnet. An additional part made to lace on to the foot of the sails of small Vessels in light winds.

Bowline. A rope fastened near the middle of the leach of a square sail, by three or four subordinate parts, called *bridles,* to keep the weather leach forward when the Ship is close-hauled to the wind.

Bowsprit. A large mast or piece of timber which runs out from the bows of a Ship.

Boxhauling. A particular method of veering a Ship, when the swell of the sea renders tacking impracticable.

Braces. Ropes by which the yards are turned about to form the sails to the wind.

To brace to. To ease off the lee braces and haul in the weather ones, in order to assist the motion of the Ship's head in tacking.

To brace up. To ease off the weather braces and haul up the lee ones.

To bring by the lee. See *to broach to.*

To broach to. To incline suddenly to windward of the Ship's course so as to present her side to the wind, and endanger her oversetting. The difference between *broaching to* and *bringing by the lee,* may be thus explained: Suppose a Ship under great sail is steering South, having the wind at N. N. W.; then West is the weather side, and the East the lee side. Now, if, by any accident, her head turns round to the westward, so that her sails are all taken aback on the weather side, she is said to *broach to;* but if, on the contrary, her head declines so far eastward as to lay her sail aback on that side which was the lee side, it is termed *bringing by the lee.*

Broken-backed. The state of a Ship so loosened in her frame, either by age, weakness, or accident, as to droop at each end.

Bumkin. A short boom or beam of timber projecting from each bow, to extend the clue or lower corner of the foresail to windward.

Buntlines. Ropes fastened to the foot ropes of square sails to draw them up to the middle of the yards, for the facility of furling.

Buoy. A sort of close cask or block of wood, fastened by a rope, called the *buoy rope,* to the anchor, in order to point out its situation.

Life-buoy. A machine thrown into the sea when a person falls overboard: it is generally made of cork, or plank, with a pole run through the middle; the lower end is loaded with lead, and on the upper is fixed a flag and bell; the flag to direct the people in the boat where to find him by day, the bell by night: it is generally made sufficiently buoyant for a man to sit upright upon it.

Cabin. A room or apartment in a Ship where any of the Officers usually reside.

Cable. A large strong rope, of considerable length, to hold the Ship when at anchor.

Caboose. The cook-room or kitchen in Merchantmen.

Call. A silver pipe, or whistle, of a peculiar construction, used by the Boatswain and his Mates to summon the sailors to their duty, and direct them in the different employments of the Ship.

Cap. A strong thick block of wood having two large holes through it, the one square, the other round; used to confine two masts together.

Capsize. To upset, or turn over.

Capstern. An instrument, in large Ships, by which the anchor is weighed out of the ground; used, at other times, when a very great purchase is required.

To carry away. To break; as, "that Ship has carried away her bowsprit;" that is, has broken it off.

Cat-heads. Two strong beams of timber over the Ship's bows, with sheaves in them, to which the anchor is hoisted after it has been hove up by the cable.

Chain-plates. Plates of iron fastened to the Ship's sides, to which the dead eyes are fixed.

Channels, or *Chain-wales.* A place built on the sides of a Ship, projecting out, with notches cut in them, in order to receive the chain-plates, and to give the rigging a greater spread.

Chestrees. Two stout pieces of wood fastened to the Ship's sides, with holes in the upper part, through which the main tack passes.

Clue of a sail. The lower corners of square-sails, but the aftermost only of stay-sails, the other lower corner being called the tack.

Clue-lines. Ropes which come down from the yards to the lower corners of the sails, by which means the clues, or lower corners of the sails, are hauled up.

Coat. A piece of tarred canvass nailed round the lower part of a mast, close to the deck, to keep the water from going down.

Cockpit. The place where the wounded in battle are carried to be dressed.

Companion. The passage from the quarter deck to the lower part of the Ship.

Conning, or *Cunning*. The art of directing the Steersman to guide the Ship in the proper course.

Cot. A particular sort of bed frame suspended from the beams of the Ship for the Officers to sleep in.

Crank. The quality of a Ship, which, for want of a sufficient weight below, is rendered incapable of carrying sail without being in danger of upsetting.

Cuddy. In East India Ships, the foremost of the two apartments under the poop deck.

Davit. A long beam of timber used as a crane, whereby to hoist the flukes of the anchor to the top of the bow, without injuring the planks of the Ship's sides as it ascends. There is also a davit of a smaller kind fixed to the long-boat, in order, if required, to weigh the anchor by the buoy-rope.

Dead-eyes. Blocks of wood with three holes in each, but no sheaves, through which the lanyards of the shrouds are rove.

Dead-lights. Strong wooden ports made exactly to fit the cabin windows, in which they are fixed on the approach of a storm.

Dead-wind. A wind blowing from that point of the Compass to which it is wanted to steer the Ship.

Dog-watch. The watches from four to six, and from six to eight in the evening.

To douce. To lower or haul down; as, "Douce the top-gallant sails;' that is, lower them down.

Down-haul. A rope by which any fore and aft sail is hauled down.

To drive. To be carried at random by the force of the wind or tide, when the Ship's anchor does not hold in the ground.

Dunnage. A quantity of loose wood laid at the bottom of a Ship to keep the cargo from being damaged in case of leaks.

Earings. Small ropes employed to fasten the upper corners of sails to the yards.

Elbow in the hawse. This expression is used when a Ship, being moored in a tide way, turns twice the wrong way, thereby causing the cables to take half a round turn on each other.

End for end. Applied to a rope that has entirely passed out of the block through which it was reeved.

Ensign The flag worn at the stern of a Ship to denote what nation she belongs to.

Fag-end. The end of any rope which is become untwisted by frequent use; to prevent which, the ends of ropes are wound round with pieces of twine, which operation is called *whipping*.

Fake. One of the circles or windings of a cable or hawser as it lies disposed in a coil.

Fall. That part of a tackle on which the people pull.

To fall off. To fall to leeward.

Fathom. A measure of six feet.

Fid. A square bar of wood or iron with a shoulder at one end, used to support the weight of the top-mast when erected at the head of the lower one. It means also a pin of hard wood tapering at one end, used to open the strands of a rope when splicing.

To fish the anchor. To draw up the flukes of the anchor towards the top of the bows after it has been catted.

Flag. A certain banner by which an Admiral is distinguished at sea from the inferior Ships of his squadron; also, the colours by which one nation is distinguished from another.

Fore-and-Aft. Throughout the whole Ship's length. Lengthways of the Ship.

Forecastle. A short deck placed in the fore part of the Ship, above the upper deck.

Foul. A term generally used in opposition to clear, and implies, entangled, embarrassed, or contrary to; as, "A Ship ran foul of us;" that is, entangled herself about our rigging.

Foul anchor. The state of the anchor when the cable is twisted round the stock or flukes.

To founder. To sink at sea by filling with water.

To freshen the hawse. To veer out, or heave in, a little of the cable, in order to let another part of it endure the stress at the hawse-holes. It is also applied to the act of renewing the service round the cables at the hawse-holes.

To furl. To wrap or roll a sail close up to the yard or stay to which it belongs, and, winding a cord round it, to keep it fast.

Gangway. That part of a Ship's side, both within and without, by which persons enter and depart.

Garboard streak. The first range or streak of planks laid in a Ship's bottom next the keel.

Gasket. A sort of plaited cord passed round the sail to keep it firm when it is furled.

Grapnell. A sort of small anchor with four or five flukes and no stock, commonly used to fasten Boats, or other small vessels.

Gratings. A sort of open cover for the hatches, resembling lattice work; serving to give light to the lower apartments, and to permit a circulation of air.

Ground tackles. A general name given to all ropes and furniture belonging to the anchor.

Ground tier. The tier of any thing that is lowest in the hold.

Gunnel, or *Gunwale.* The upper edge of a Ship's side.

Gun-room. A division in the aftermost part of the lower deck, for the use of the Gunner and his stores.

Guy. A rope used to keep steady any weighty body while it is hoisting or lowering.

Halliards. Ropes by which any sail is hoisted or lowered.

Handing. The same as furling.

Hawse-holes. Certain holes cut through the Ship's bows on each side the stem, through which the cables pass.

Hawser. A kind of small cable used on various occasions.

To heave. To turn about the capstern, or other machine of the like kind, by means of bars, handspikes, &c.

To heave short. To draw so much of the cable into the Ship, as that she will be almost perpendicular over her anchor.

To heave-to. To stop the Ship's course when she is advancing, by arranging the sails in such a manner that they shall counteract each other, and prevent her from either advancing or retreating; it is generally done by backing the fore or main top-sail.—See Lying-to.

Heave of the sea. The power that the swell of the sea has upon a Ship in driving her out, or faster on, in her course, and for which allowance is made in the day's work.

Helm. The instrument by which a Ship is steered: it includes the rudder, the wheel, and the tiller.

To hoist. To draw up any body by the assistance of one or more tackles. Pulling by means of a single block is never termed hoisting, except only the drawing of the sails upwards along the masts or stays.

Hold. The space between the lower deck and the bottom of the Ship; where her stores and cargo lay. To stow the hold, is to place the things in it.

Horse. A rope reaching from the middle of a yard to its arms or extremities, for the men to stand on when they are loosing, reefing, or furling a sail.

Hoy. A small vessel, usually rigged as a Sloop, and employed in carrying goods from one place to another.

Hulk. A name given to any old vessel laid up as unfit for further sea service.

Hull. The frame or body of a Ship, exclusive of her masts, yards, sails, and rigging.

Hull down. A term applied to a Ship when she is at such a distance as that only her masts and sails are to be seen.

Jack. A sort of flag, or colours, displayed from a staff erected on the bowsprit end.

Jamming. The act of enclosing any object between two bodies, so as to render it immoveable. A cask, box, or any other thing, is also said to be jammed, when it cannot be dislodged without difficulty.

Jeers. The tackles by which the lower yards of a Ship are hoisted or lowered down.

Jeer-blocks. The blocks through which the jeers are rove.

Jib. The foremost sail in a Ship, set upon a boom which runs out from the bowsprit.

Jib-boom. A spar that runs out from the bowsprit end.

Jolly-boat. The smallest Boat belonging to a Ship.

Junk. Old cable or old rope.

Jury-mast. A temporary or occasional mast, erected in a Ship in the place of one which has been carried away by accident.

Keckling. The art of winding old rope round a cable, to preserve its surface from being rubbed against the Ship's bows or bottom.

Kedge. A small anchor with an iron stock.

Keel. The principal piece of timber in a Ship, which is usually first laid on the blocks in building.

Keel-hauling. The punishment of dragging a person backwards and forwards under the Ship's keel for certain offences. This practice is now laid aside in the British Navy, but is practised by other powers.

Keelson, or *Kelson*. A piece of timber forming the interior of the keel being laid on the middle of the floor timbers immediately over the keel, and serving to unite the former to the latter.

Kentledge. Pigs of iron for ballast, laid upon the floor, near the kelson, fore and aft.

Kink. A sort of twist or turn in a cable or rope.

To labour. To pitch or roll heavily in a turbulent sea, by which means the masts and hull of the Ship are greatly endangered.

Landfall. The first land discovered after a sea voyage.

Laniard. A short piece of rope or line, fastened to several machines in a Ship, and serving to secure them in a particular place, or to manage them more conveniently; such are the laniards of the gun-ports, the laniard of the buoy, the laniard of the cat-hook, &c. The principal laniards used in a ship are those employed to extend the shrouds and stays of the masts by their communication with the dead eyes and hearts, so as to form a sort of mechanical power, resembling that of a tackle.

Larboard. Left. A name given by seamen to the left side of the Ship, when the spectator's face is turned towards the head.

Larboard tack. The situation of a Ship sailing with the wind on her left side.

Leak. A chink or breach in the decks, sides, or bottom of a Ship, through which the water passes into her hull.

Leaches. The borders or edges of a sail.

Lee. That part of the hemisphere to which the wind is directed, to distinguish it from the other part, which is called to windward.

Lee-shore. That shore, upon or against which the wind blows.

Lee-way. The lateral movement of a Ship to the leeward of her course, or the angle which the line of her way makes with her keel when she is close-hauled.

Lifts. The ropes which come from the mast heads to the ends of yards, and by which they are suspended when lowered down.

Limbers, or *Limber-holes*. Square holes cut through the lower part of a Ship's floor timbers, very near the keel; forming a channel for water, and communicating with the pump well throughout the whole length of the floor.

List. An inclination to one side; as, "The Ship has a list to port;" that is, she leans to the left.

Log. A machine by which the Ship's rate in going is ascertained.

Log-board. Two boards shutting together like a book, and divided into several columns, containing the hours of the day and night, the directions of the wind, the Ship's course, and all the material occurrences that happen during the 24 hours.

Log-book. A book into which the contents of the log-board is daily transcribed at noon.

To luff. To come nearer to the wind, or to bring the Ship's head more to windward.

Lumpers. Labourers employed to load or unload a Merchant's Ship when in harbour.

Lying-to. The situation of a Ship when she is retarded in her courses, by arranging the sails in such a manner as to counteract each other with nearly an equal effort, and render the Ship almost stationary with respect to her progressive motion or head-way.

Magazine. A close room built in a Ship's hold, where the powder is kept.

To make the land. To discover it from a distant situation.

To make sail. To increase the quantity of sail already set, either by unreefing or setting others.

Marling-spike. An iron pin tapering to a point, and principally used to separate the strands of a rope when splicing.

Maul. A large iron hammer used for various purposes.

Messenger. A large rope used to unmoor or heave up the anchors of a Ship, by transmitting the efforts of the capstern to the cable.

To miss stays. A Ship is said to miss stays when her head will not fly up in the direction of the wind in order to get her on the other tack.

To moor. To secure a Ship with two anchors and cables.

Mouse. A kind of ball, or knob, wrought upon the collar of the stays.

Mustering. The act of calling over a list of the whole Ship's company, or any particular detachment thereof, who are accordingly to answer to their names.

Narrows. A small passage between two lands.

Neap tides. Those tides which happen when the Moon is nearly at the second and fourth quarters; the neap tides are low tides in respect to their opposites, the spring tides.

Nippers. Certain pieces of cordage used to fasten the messenger to the cable in heaving up the anchor.

Nothing off. A term used to direct the man at the helm not to go from the wind.

Near, or *No nearer.* Not to come any nearer.

Oakum. The substance into which old ropes are reduced when they are untwisted and drawn asunder.

Offing. Out at sea, or at a competent distance from the shore.

Orlop deck. The deck on which the cables are stowed.

To over-haul. To clear away or disentangle any rope or tackle: also, to come up with the chace; as, "We over-haul her;" that is, we gain ground on her.

Palm. An instrument used instead of a thimble in sewing canvass.

To parcel a rope. To put a quantity of old canvass round a rope before the service is put on.

Parting. The state of being driven from the anchors by breaking the cable through the violence of the winds, waves, &c.

Pawl. A short bar of wood or iron fixed close to the capstern or windlass of a Ship, to prevent those engines from rolling back, or giving way, when they are charged with any great effort.

To pawl the capstern. To fix the pawls so as to prevent the capstern from recoiling during any pause of heaving.

To pay. This term, applied to naval affairs, implies to daub or anoint the surface of any body, in order to preserve it from the injuries of the water or weather.

To pay the seams. To pour hot pitch upon the seams after caulking.

To pay out the cable. To shove it out at the hawse-holes.

Pendant. The long narrow flag worn at the mast-head of all Ships of war in actual service.

Brace pendants. Those ropes that secure the brace blocks to the yard arms in ships of war: they are generally double, in case that, one being shot away, the other may secure the yard in its proper position.

Broad pendant. A kind of flag terminating in one point, used to distinguish the Chief of a squadron.

Port. A term used for larboard, or the left side. Also, a harbour or haven.

Port the helm! The order to put the helm over to the larboard side.

Points. Flat pieces of plaited cordage, tapering from the middle towards each end, whose lengths are generally double the circumference of the yard, and used to reef the courses or topsails.

Poop. The highest and aftermost deck of a Ship.

Ports. The embrasures or openings in the sides of a Ship of war, wherein the artillery is ranged upon the decks above and below.

Preventer. An additional rope employed at times to support any other, when the latter suffers an unusual strain, particularly when blowing fresh, or in a gale of wind.

Quarter. That part of a Ship's side which lies towards the stern, or which is comprehended between the aftermost parts of the main chains and the Ship's stern, whence it is terminated by the quarter pieces.

Quarters. The respective stations of the officers and people in time of action; hence, *quartering* signifies distributing the men to different places.

Quarter bill. A list of the Ship's company, with their stations in time of action noticed therein.

Quarter wind. A term applied to the wind when it blows in, abaft the main shrouds.

Raft. A sort of float, formed by an assemblage of various planks, or pieces of timber, fastened together side by side, so as to be conveyed more commodiously to any short distance, in a harbour or river, than if they were separate.

Raft port. A square hole cut through the stern of a Ship, immediately under the counter, to receive planks and other pieces of timber, which, on account of their length, could not be got into the hold otherways.

Range of a cable. A sufficient length of cable drawn upon deck before the anchor is cast loose, to admit of its sinking to the bottom without any check.

Ratlines. Small lines which traverse the shrouds of a Ship horizontally at regular distances from the deck upwards, and forming a variety of ladders whereby to climb or descend from any of the mast heads.

Ready about! A command of the boatswain to the crew; and implies that all the hands are to be attentive, and at their station for tacking.

Reef. A certain portion of a sail comprehended between the top or bottom, and a row of eyelet holes generally parallel thereto. The intention of the reef is to reduce the surface of the sail in proportion to the increase of the wind; for which reason there are several reefs parallel to each other in the superior sails: thus, the top-sails of a Ship are generally furnished with three or four; and there are always three or four reefs parallel to the foot or bottom of those main-sails and fore-sails which are extended on booms.

To reeve. To pass the end of a rope through any hole, as the channel of a block, the cavity of a thimble, cleat, cringle, ring-bolt, &c.; hence, to pull a rope out of a block is called *unreeving*.

Ribs of a Ship. A figurative expression for the timbers.

To ride. To be held in a particular situation by one or more anchors and cables.

To ride at anchor. A term applied to a Ship when she is held by her anchors, and is not driven by wind or tide. To ride athwart, is to ride with the Ship's side to the sea.

To right the helm. To bring it into midships after it has been put either to starboard or to port.

To rig. To fit the shrouds, stays, braces, &c. to their respective masts and yards.

Rigging. A general name given to all the ropes employed to support the masts, to extend or reduce the sails, or to arrange them to the disposition of the wind.

Road, or *Road-stead.* A bay or place of anchorage at some distance from the shore on the sea coast.

Robands, or *Rope-bands.* Short flat pieces of plaited rope, having an eye worked at one end: they are used in pairs to tie the upper edges of the square sails to their respective yards.

Round-house. A name given, in East-Indiamen and other large Merchant Ships, to a cabin or apartment built on the after part of the quarter-deck, and having the poop for its roof: this apartment is frequently called the *Coach* in Ships of war. Round-house is also a name given, on board Ships of war, to certain necessaries built near the head, for the use of the Mates, Midshipmen, and Warrant Officers.

Rounding. Old ropes wound firmly and closely about that part of the cable which lies in the hawse, or athwart the stern, &c.: it is used to prevent the cable from being chafed.

To rouse. To pull together upon the cable or ropes, without the assistance of tackles.

Rudder. The machine by which a Ship is steered.

Run. The aftermost part of a Ship's bottom, where it grows extremely narrow as the floor approaches the stern post. Run is also the distance sailed by a Ship; it is likewise a term used among sailors to imply the agreement to work a single passage from one place to another, as, from Jamaica to England, &c.

Rullocks. The nitches in a Boat's side in which the oars are placed when employed in rowing.

Sally port. A large port in each quarter of a Fire-Ship, out of which the officers and men make their escape into the Boats as soon as the train is fired.

Scant. A term applied to the wind when it becomes unfavourable to a Ship's course, after having been fair.

Scantling. The dimensions of any piece of timber with regard to its breadth and thickness.

Scraper. An iron machine, having two or three sharp edges, used to scrape off the dirty surface of the planks of a Ship's sides or decks, or to clean the top-masts, &c.

To scud. To go right before the wind: in a tempest, going in this direction, without any sail set, is called *spooning*.

Scuppers. Certain channels cut through the water-ways and sides of a Ship at proper distances, and lined with sheet lead, in order to carry the water off the decks into the sea.

Scuttle. A small hatchway, or hole, cut for some particular purpose through a Ship's decks or sides, or through the coverings of her hatchways, and furnished with a lid, which firmly encloses it when necessary.

Scuttling. Cutting large holes through the bottom or sides of a Ship, either to sink her, or unload her expeditiously when stranded.

Seizing. The operation of fastening any two ropes, or different parts of one rope, together, with a small line or cord.

To serve. To wind something about a rope to prevent it from chafing.

Shank. The beam or shaft of an anchor.

Shank painter. A short rope and chain which sustains the shank and flukes of an anchor against the Ship's side after it has been fished.

Sheave. The wheel on which the rope works in a block.

Shear. The longitudinal curve in a Ship's sides or deck.

Sheer hulk. An old Ship of War fitted with an apparatus for fixing or taking out the masts of Ships, as occasion may require.

Sheers. Spars lashed together, and raised up, for the purpose of hoisting in and getting out the lower masts of a Ship.

Sheet. A rope fastened to one or both of the lower corners of a sail, in order to extend and retain it in a particular situation.

When a Ship sails with a side wind, the lower corner of the main and fore-sails are fastened by a tack and a sheet, the former being to windward, and the latter to leeward: the tack is, however, only disused with a stern wind; whereas the sail is never spread without the assistance of one or both of the sheets: the stay-sails and studding-sails have only one tack and one sheet each: the stay-sail tacks are fastened forward, and the sheets drawn aft; but the studding-sail tacks draw the outer corner of the sail to the extremity of the boom, while the sheet is employed to extend the inner corner.

To sheet home. To haul home a sheet, or to extend the sail till the clue is close to the sheet-block.

Ship-shape. In a seaman-like manner; as, "That mast is not rigged ship-shape,"—"Put her about ship-shape," &c.

Shivering. The state of a sail when it shakes or flutters in the wind.

Shoe of the anchor. A small block of wood, convex on the back, and having a hole sufficiently large to contain the point of the anchor fluke on the fore-side: it is used to prevent the anchor from tearing the planks on the Ship's bow when ascending or descending.

Shrouds. A range of large ropes, extended from the mast heads to the right and left sides of a Ship, to support the masts, and enable them to carry sail.

Skidds. Long compassing pieces of timber, formed to answer the vertical curve of the Ship's side. They are notched below so as to fit closely upon the wales, and extend from the main-wale to the gun-wale, being strongly nailed to the side. Their use is to preserve the planks of the Ship's side when any weighty body is hoisted or lowered against it.

Slip. A place lying with a gradual descent on the banks of a river or harbour, convenient for Ship-building.

To slip the cable. To let the cable run quite out when there is not time to weigh the anchor.

To slue. To turn any cask or package round another way.

To sound. To try the depth of the water with the plummet sunk from a ship to the bottom.

To splice. To join the two ends of a rope together, or to unite the end of a rope to any part thereof, by interweaving the strands in a regular manner.

Split. The state of a sail rent by the violence of the wind.

Spray. The sprinkling of the sea which is driven from the top of a wave in stormy weather.

Spring. A crack running transversely or obliquely through any part of a mast or yard, so as to render it unsafe to carry sail thereon.

Spring tides. The tides at New and Full Moon, which flow highest and ebb lowest.

Spring stays. A smaller sort of stays: they are placed above the larger ones, and are intended to answer the purpose of the latter, if they should be shot away.

Spun yarn. A small line, or cord, formed of two, three, or more rope yarns, twisted together by a winch; the yarns are usually drawn out of the strands of old cables, and knotted together: it is used for various purposes, such as seizing and serving ropes, weaving mats, &c.

Starboard. The right side of a Ship, when the eye of the spectator is turned towards the head.

Stay. A large strong rope, employed to support the mast on the fore part, by extending from its upper end towards the stern of the Ship, as the shrouds are extended on each side.

To stay a Ship. To arrange the sails, and move the rudder, so as to bring the Ship's head to the direction of the wind, in order to get her on the other tack.

Steady! The command given to the helmsman, in a fair wind, to steer the Ship in the line on which she advances at that instant, without deviating to the right or left; to which the helmsman answers, " Steady," to shew his attention to the order.

Steerage. An apartment before the great cabin, from which it is separated by a partition or bulk-head.

Stem. A circular piece of timber, into which the two sides of a Ship are united at the fore end; the lower end is scarfed to the keel, and the bowsprit rests on the upper end.

To stem a tide. To acquire a velocity in sailing against the tide equal to the force of the current.

Stern. The posterior part of a Ship, or that part which is presented to the view of a spectator placed on the continuation of the keel behind.

Stoppers. Certain short pieces of rope, which are usually knotted at one or both ends, according to the purpose for which they are intended.

Stoppers of the cable, commonly called *deck-stoppers,* have a large knot and laniard at one end, and are fastened to a ring-bolt in the deck by the other; they are attached to the cable by the laniard, which is fastened securely round both by several turns passed behind the knot, or about the neck of the stopper, by which means the cable is restrained from running out of the Ship when she is at anchor.

Strand. One of the twists, or divisions, of which a rope is composed; it also implies the sea beach.

Stranded. This term, speaking of a cable or rope, signifies that one of its strands is broken;—applied to a vessel, it means that she has run aground on the sea shore, and is lost.

To stream the buoy. To let it fall from the Ship's side into the water, previous to casting anchor.

Stretch out! A term used to men in a boat, when they should pull strong.

To strike. To lower or let down any thing; used, emphatically, to denote the lowering of colours, in token of surrender, to a victorious enemy.

To strip the masts. To unrig a Ship, or deprive the masts of their machinery or furniture.

Sued, or *Sewed.* When a Ship is on shore, and the water leaves her, she is said to be sued; if the water leaves her two feet, she sues, or is sued, two feet.

To surge the capstern. To slacken the rope heaved round upon it.

Swab. A sort of mop formed of a large bunch of rope-yarns, and used to clean the deck and cabins of a Ship.

To sway. To hoist.

To tack. To change the course from one board to another, or to turn the Ship from the starboard to the larboard tack, or vice versa, in a contrary wind. This is called *going about*, and is performed by turning the Ship's head suddenly to the wind; whereby her head-sails being thrown aback, they receive the impression of the wind in a new direction, and cause her to fall off from the wind to the other tack.

Tackle. A machine formed by the communication of a rope with an assemblage of blocks, and known in mechanics by the name of pulley.

Taffarel. The uppermost part of a Ship's stern.

Tarpawlin. A broad piece of canvass well daubed with tar, and used to cover the hatches of a Ship at sea, to prevent the penetration of the rain or sea water, which may at times rush over the decks.

Taunt, signifies high or tall. It is particularly expressed of the masts, when they are of an extraordinary length; as *square* is applied to yards on the same occasion.

Tell-tale. A small piece of wood traversing in a groove across the front of the poop deck, and which, by communicating with a small barrel on the axis of the steering wheel, indicates the situation of the helm.

" *Thus, very well thus.*" The order to the helmsman to keep the Ship in her present direction when sailing close-hauled.

To tide. To work in or out of a river, harbour, or channel, by favour of the tide, and anchoring whenever it becomes adverse.

Tide-gate, or *Tide-way.* A place where the tide runs strong.

Tier. A name given to the range of cannon mounted on one side of a Ship's decks.

Tier of the cable. A range of the fakes or windings of a cable which are laid within one another in an horizontal position.

Cable tier. The space in the midst of a cable when it is coiled; also the place in which it is coiled.

Tiller. The bar or lever employed to turn the rudder in steering.

Timbers. The ribs of a Ship.

Tompion. A circular piece of wood, or bung, used to stop the mouth of a cannon to keep the wet out.

Tort, or *Taut*, signifies tight.

To tow. To draw a Ship or Boat forward in the water by means of a rope attached to another vessel or boat, which advances by means of rowing or sailing.

Tow-line. A small hawser, generally used to remove a Ship from one part of a harbour to another.

Trade winds. Certain regular winds blowing within or near the Tropics, and are either periodical or perpetual.

Transoms. Certain beams, or timbers, extended across the sternpost of a Ship to fortify her after-part, and to give it the figure most suitable to the service for which she is calculated.

Traveller. One or more iron thimbles with a rope spliced round them, sometimes forming a kind of tail, but more generally a species of grommet.

Traverse. To go backwards and forwards.

Treenails, or *Trunnels.* Long wooden pins employed to connect the planks of the Ship's side and bottom to the corresponding timbers, and are justly esteemed superior to spike-nails, or bolts, which are liable to rust and loosen. their thickness is usually proportioned to the length of the Ship, allowing one inch to every hundred feet.

To trice, or *trice up.* To haul up and fasten.

Trough. A name given to the hollow, or interval, between two high waves, which resembles a broad and deep trench, perpetually fluctuating. A Ship rolls heaviest when she is in the trough of the sea.

Truck. A round piece of wood put upon the top of flag-staffs, with sheaves on each side for the halyards of flags to reeve in.

Turning to windward. That operation in sailing wherein a Ship endeavours to make a progress against the wind by a compound course inclined to the place of her destination: this is otherwise called *plying* or *beating to windward.*

Vane. A small kind of flag worn at each mast head.

To veer. To let out; as, "veer away the cable;" that is, let out the cable:—it likewise signifies to shift; as, "the wind veers;" that is, it shifts or changes.—See *To ware.*

Viol. A large rope used to unmoor or heave up the anchors, by transmitting the effort of the capstern to the cable: it is more generally called the *messenger.*

To unbit. To remove the turns of a cable from off the bits.

To unrig. To deprive a Ship of her standing and running rigging.

To unfurl. To cast loose the gasket of a sail.

To unbend. To cast off the sail from the yard.

Uvrow. The piece of wood by which the legs of the crowfoot are extended.

Waist. That part of a Ship which is contained between the quarter deck and the forecastle.

Wake. The path or track impressed in the water by a Ship passing through it, leaving a smoothness in the sea behind. A Ship is said to come into the wake of another when she follows her in the same track, and is chiefly done in bringing Ships to, or forming the line of battle.

To ware, or *veer.* To cause a Ship to change her course from one board to another, by turning her stern to the wind; contrary to tacking.

Warp. A hawser, or small cable.

To warp. To draw a Ship against the wind, &c. by means of anchors and hawsers carried out.

To weather. To sail to windward of some Ship or headland.

Weather-beaten. Shattered by a storm.

Water-line. The line made by the water's edge when a Ship has her full complement of stores in.

To work to windward. To make a progress against the direction of the wind.

To would. To bind round with ropes; as, "the mast is woulded."

Yard. A long piece of timber suspended across the masts, on which the sails are spread.

Yarn. One of the threads of which the ropes are composed.

EXAMINATION

OF A

YOUNG SEA OFFICER.

QUESTION. You are ordered to a ship, lying in dock, how would you prepare to take her out of dock?

ANSWER. I would get on board what kentledge was requisite, stream anchor and cable, kedge anchor, hawser and tow-lines, with some spare ropes for guys, to keep her fair for the dock gates; also buoy and buoy ropes for stream and kedge anchors.

Q. Being out of dock, how would you proceed?

A. I would clear the limbers, sweep the hold, and take on board the remainder of the kentledge, which I would level from the fore part of the fore-hatchway, to the after part of the after-hatchway.

Q. Previous to coming out of dock, how much ballast ought you to have on board?

A. About 80 tons in a large China ship; and 60 in one of a smaller class.

Q. What are the limbers, and their use?

A. They are holes of 4 inches square, cut out of the floor timbers close to the keel, to give free passage for the water to the pump-well.

Q. How do you clear the limbers?

A. By lifting the limber kentledge up, and putting my hand down between the limbers to clear them of chips or other dirt with which they may happen to be choaked.

Q. What do you mean by limber kentledge?

A. They are pigs of iron fitted to go down between the floor timbers, to prevent any dirt getting down between the limbers.

Q. What are the floor timbers?

A. The floor timbers are connected with the keel, about 14 inches thick, and reach between 8 and 9 feet towards the bilge of the ship; they are tree-nailed down to the keel above the dead-wood.

Q. What do you mean by the dead-wood?

A. Large chocks of wood that are put above the keel, and below the floor timbers.

Q. How do you lay the kentledge?

A. From the fore part of the fore-hatchway, to the after part of the after-hatchway.

Q. Why do you not continue the kentledge further forwards?

A. Because it is necessary to have the dead weight as much in the body of the ship as possible.

Q. Where do you stow your water?

A. From the stantion abaft the fore-hatchway, nearly to the bulk head of the coal-hole.

Q. Where do you stow your wet provisions?

A. I would leave out two longers of my water forward, and stow them there, taking care to have my first expenditure uppermost.

Q. How would you begin to stow your first butt of water?

A. If it were to my advantage, I would begin from the wings.

Q. How would you know that?

A. By turning the empty butts in; or by measuring with two bilge hoops.

Q. Where would you stow your dry provisions?

A. In the after hold if there be room, if not, abreast of the after-hatchway.

Q. Where would you stow your beer?

A. On the upper height of water in the fore-hold, if for the ship's use; otherwise abreast the pump-well.

Q. Outward-bound where would you stow the Honourable Company's bales?

A. In the after hold, from the stantion abaft the after-hatchway, to the bread room bulk head.

Q. And how would you stow them?

A. On their flats.

Q. Why on their flats in particular?

A. Because, if perchance the bales get wet, the lower pieces only will be injured by it;—whereas, should it be stowed on its edge or end, and any water get to it, the whole would be damaged.

Q. In stowing the Honourable Company's bales, what dunnage would you give them?

A. Eight or nine inches fathom-wood.

Q. Where would you dunnage most?

A. About the pump-well, in the wake of the chain and masts, also the floor timbers.

Q. Why in the wake of the floor timbers?

A. Because when the ship lays along, she will have most water there.

Q. Why in the wake of the chains?

A. Because ships are apt to strain there, owing to the weight of the masts and rigging when she lays along, and also on account of the large bolts that are there, where she is most apt to leak.

Q. What do you stow abreast the pump-well?

A. The Honourable Company's lead.

Q. Why so?

A. Because I would endeavour to have the dead weight as much in the body of the ship as possible;—and also, to make up the deficiency of the well; it would likewise leave less breakage there than any other place.

Q. Where would you stow the Honourable Company's iron?

A. In the wings abreast the main hatchway, and in the wings of water.

Q. In a homeward-bound passage how would you dunnage having only bales to take on board?

A. I would level the hold to about 3 or 4 inches above the keelson.

Q. On which side of the ship would you take your anchors on board?

A. The sheet, small bower and kedge anchors, on the starboard side; the best bower, spare and stream anchors on the larboard side.

Q. How many cables on each side do East Indiamen carry?

A. Two on the sheet, two on the best bower, and one on the small bower.

Q. At what depth do your hand and chain pumps begin to suck?

A. The chain pumps at 10 or 12 inches from the bottom of the well, and the hand pumps at 5 or 6 inches.

Q. How do the hand and chain pumps work?

A. The hand pump with a break spear, upper and lower box; the chain pumps with a chain hove round within an iron winch, the chain reeved through the pumps, and round the roller, that is, fixed at the bottom of them.

Q. How are your pumps fixed?

A. They are fixed between the floor timbers, with a score cut in the side of the pumps that they may rest on one of the timbers; and wedged upon the lower and middle decks with a plate of iron under each pump, to prevent the suction injuring the ship's bottom.

Q. How do you reeve the laniards?

A. The knot under the end of the shroud, that is, turned up, and the side in

Q. How do you turn in the dead eyes of the shrouds?

A. With the lay of the rope.

Q. How do you know the fore from the after part of a sail?

A. By the head rope and tabling which is abaft the sail, and reef-band which is before it.

Q. What do you call those ropes the sail is fixed to?

A. The bolt rope.

Q. The particular name of each?

A. The head rope, leach rope, and foot rope.

Q. How is the sail fixed to these?

A. It is sewed in all, except the foot rope.

Q. How is it fixed there, and why?

A. It is marled; for, on account of its being wormed, parcelled, and served, I should not be able to get my needle through it on fixing the foot-rope to the sail.

Q How would you lay a top-sail in the slings, if you intend sending it up from the starboard side?

A. The larboard yard-arm uppermost, and folded in three.

Q. How do you set the top-mast rigging up?

A. With a runner and top-burton.

Q. In what manner would you stay your masts?

A. My main-mast should incline a little aft, and the fore-mast a little forward, that there may be a greater distance between them for the purpose of causing the stay-sails to draw the better.

Q What do you mean by a guess-warp?

A. It is carrying out a hawser and anchor in a boat, to heave a ship either against wind or tide;—when the anchor is gone, the end of the hawser is received on board, in readiness to heave as occasion requires, from which circumstance it is called a guess-warp.

Q. What do you mean by kedging a ship?

A. It is when a ship is dropping with the tide, having a kedge anchor and hawser in a boat, and letting go the anchor, when the ship requires it to bring her head the right way.

Q. How do you moor a ship head and stern?

A. On letting go my first anchor, I let the ship swing to it, then carry out another astern (the cable being passed through the gun-room port), and when gone, heave in taut.

Q. How would you moor your Ship at Gravesend?

A. I would come-to with my small bower, veer the service into the hawse, and then hang my best bower-anchor to the long-boat, and with the tide drop her a-stern; when the cable is taut, let go the anchor, first letting go the shank-rope, to keep the cable more taut.

Q. How would you hang the anchor to the long-boat.

A. Take the buoy-rope over the roller (which is in the middle of the stern of the long-boat), bring the bight round the main thwart, cockbill the anchor, hook the cat to the anchor, and lower away, until the flukes of the anchor are clear of the boat's bottom; then make fast the buoy-rope, have a shank-rope through the ring (which is at the boat's stern-post), pass it round the shank of the anchor, make it fast to the after-thwart, lower away, and unhook the cat; then veer away the cable: I would be careful to heave the buoy overboard before I let go the anchor.

Q. How do you moor in the Downs?

A. With my best bower to the S. W., I would veer away with the last quarter flood, and moor with the small bower to the N. E.

Q. How would you unmoor in the Downs with the wind at North?

A. I would splice my stream-cable to my small bower, and veer away at half ebb, that I might have time to stow my best bower, and shorten in my small bower cable, before the Ship tends to windward.

Q. Proceed to unmoor Ship as it is done in the Navy.

A. I would send for the master to see that the hawse is clear, turn all hands up to unmoor Ship, lay the capstan bars for shipping, call the mate to see the messenger passed for the best bower, rig the davit out, because it will take it up the first quarter flood, get the cat and fish to pass for the best bower, stretch along the fish tackle; quarter-masters down in the tier, and stand by to veer away the small bower cable; ship the capstan bars, pin and swift them, clap on the stoppers before the bitts, and bring-to the messenger: at the same time unbit the best bower, rowse aft the slack of the cable, heave taut, take off the stoppers, hold on the messenger, and heave away; veer away the small bower cable; clap on the nippers; thick and dry for weighing, heave cheerly; the anchor's away, keep fast the small bower cable; quarter-master take hold of the helm; look out for the anchor; the anchor is in sight; heave and pawl the capstan; hook the cat; haul taut, and take a turn; surge the messenger round the capstan; take off the nippers; out cable; cable enough; haul cat; belay the catfall; pass the stoppers; hook the fish; try fish by hand; haul away the fish; belay the fish tacklefall; pass the shank painter; bowse-to the stock tackle; belay the shank painter; make fast the stopper and stock lashing; come up cat and fish; unhook both; haul the buoy in; then shift the messenger for the small bower, and bring to; clap on the stoppers before the bitts, and unbit the cable; rowse aft the slack of the cable; man the capstan; hold on the messenger; forecastle-men rig out the davit for the small bower;

when the anchor is a-peak, send the top-men to loose the sails; man the yards; stretch along the topsail sheets; let go the topsail; reef tackles, buntlines, and cluelines; foot the sails out of the top; haul home the topsail sheets; stretch along the topsail halyards, and man them; quartermaster and boatswain's mates attend to the braces; hoist away the topsails; belay the halyards; trim the sails; heave up the anchor, stow it as before, and haul the buoy in.

Q. How would you unmoor in the Downs, with the wind S. E. or S.?

A. Veer away on the best bower cable, and take the small bower anchor up first; and proceed as before; then heave in to the short service on the best bower, &c. If the anchor has great hold, and afraid of standing the messenger, clear away the main capstan, and lash a block, or purchase-blocks, on the cable, and one to the main-mast, or one to the two ports abreast of the main-mast; reeve a hawser through them, and heave on both capstans together.

Q. How do you cast a Ship, when intending to get under weigh?

A. If I am to cast her to starboard, I would haul in my larboard braces forward, and let my after-yards lay square; I may hoist the fore-top-mast stay-sail, and keep the sheet to windward to help her; if I am to cast her to port, I would haul in the contrary braces; when cast, fill the head-sails, and brace up as circumstances require.—N. B. If a Ship is wind-rode, as soon as the anchor is right up and down, put the helm the way you would have her cast, setting in the same braces abaft, and the contrary forward; but if she is tide-rode, the helm must be put the contrary way to which you would have her cast, and set in the braces forward: whichever way the helm is, the braces abaft must be the contrary.

Q. Suppose you are close upon a wind, in moderate weather, with all your sails set, how will you tack the Ship?

A. I would hand down the lee bow-lines, stretch along the weather-braces, the weather sheets, and lee-tacks; then put the helm a-lee, let go the fore sheet, lee fore-top-sail brace and fore-top bowline, jib and stay-sail sheets. When the fore-top-sail touches, brace to, and help her; when aback, brace up, and help her: when the wind is out of the after sails, raise tacks and sheets, shift the stay-sail tacks, and haul over the stay-sail sheets; cant the sprit-sail yard; when the wind is rather ½ a point on the bow, if sure of coming about, haul the main-sail.—N. B. One watch of the top-men on the quarter-deck and forecastle, to set up the weather-breast-back-stays.—If she has stern way, shift the helm, and square the sprit-sail yard; haul on board the main tack, and aft the main sheet. Brace up the main yard, when the after sails are full; haul off all, and haul on board the fore tack; keep in the weather braces forward, and let her come to; then brace up; haul aft the fore sheet, jib and stay-sail sheets; set the back-stays up, and haul the bow-lines; then haul taut the weather-braces, lee-tacks, and weather-sheets; have the braces let go at once; when the word is given to haul main-sail (all the hands on the braces should keep hauling taut in for the run), the yards will swing of themselves.

Q. How would you tack a Ship under her three top-sails?

A. I would put the helm a-lee, ease off the lee fore-top-sail brace, keep fast the fore-top bow-line; when the fore-top-sail touches, brace to, and help her; when the wind is a-head, haul the main-top-sail, and shift the helm; then brace up the main yard, and haul the main-top bow-line; when the after sails are full, let go, and haul · keep in the weather-braces forward; and, when she comes to, brace sharp up, haul the main and fore-top bow-lines, and haul taut the weather-braces.

Q. How do you veer or wear a Ship with all her sails set?

A. I would haul the mizen up, and the mizen stay-sail down, or brail it up, hard a-weather the helm, shiver the main top-sail, let go the main and main-top bow-lines, ease off the main sheet, the lee main brace, and round in the weather-brace. When the wind is abaft the beam, raise the main tack; when the wind is aft, square the head-yards, and get the other tacks on board; haul aft the sheets, shift the jib and stay-sail sheets over the stays, and, as she comes to, haul the mizen out; hoist the mizen stay-sail, and haul aft the sheet; brace the head-yards up, haul the bow-lines, and trim all sharp. If a fresh wind, and should be proper to shorten sail, in top-gallant-sails, down jib and stay-sails, take one or two reefs in the top-sails.

Q. It blows hard, would have you proceed to close-reef the top-sails?

A. I would let run the halyards, and haul the yards close down by the clue-lines and down-haul tackles: if the wind is large, man the clue-lines and bunt-lines, let go the sheets, and clue them close up; haul in the weather-brace, and spill the sail as much as possible; then haul out the reef-tackles; send men up, and haul out the weather earing first, then the lee one, and reef away, hauling the other reefs up before the yard: if the Ship is upon a wind when the top-sail yard is down, let go the bow-line. It is mostly the way to man the clue-lines and the bunt-lines, to ease off the lee-sheet and clue it up; then man the weather-brace, let go the lee-brace, ease off the weather-sheet and clue it up, hauling in the weather-brace and bunt-lines at the same time; when the sail is spilled, haul out the reef-tackles, and reef as before. But to keep the sail from splitting or shaking (especially if it be wet), it is the best way to man the clue-lines, bunt-lines, and weather-brace; let go the lee-brace, ease off the weather-sheet, hauling up the clue-line, and in with the weather-brace at the same time; when in enough, ease off the lee-sheet, clue up, &c.—N. B. To set a topsail on a wind when it blows strong, always haul the lee-sheet home first, then the weather one, &c. &c. as before.

Q. It blows harder, you must take in your top-sails?

A. I would take in the fore and mizen top-sails first, because it will ease the Ship forward (for when it blows hard we generally have a head sea, and she keeps-to the better); let go the fore-top bow-lines, lower away the halyards, man the clue-lines and bunt-lines, clue close up, and haul out the reef-tackles, haul in the weather-brace, steady the lee-brace, haul taut the top-sail halyards; send the people up to hand the sail, and when up, before they go on the yard, I'll clap the rolling tackle on to steady her (all the top-sails should be taken in the same way); after that, if squally, take in the main-top-sail; and then the Ship is under her courses.

Q. How would you veer a Ship under her courses?

A. I would haul the mizen and main-sail up, and down with the mizen stay-sail; square the after yards, hard a-weather the helm, man the weather fore-brace, and ease off the lee-brace and fore bow-line; ease off the fore-tack, and stand by to haul on board the other; keep her large, if room, until I get the tack on board and belay it; then luff up to the wind, haul aft the fore-sheet and brace up the fore-yard, set the after sails, aboard main-tack, aft the main-sheet, brace all up, and haul the bow-lines; when my sails are trimmed, shift the rolling tackles on the top-sail yards.

Q. Suppose you are lying-to in a hard gale of wind, under a reef main-sail; you want the Ship's head on the other tack; how will you veer in a great sea?

A. I will watch her falling off, and put the helm a-weather when she does; ease off the main sheet; if that will not do, I'll man the fore-shrouds, and get tarpaulins and hammocks or spare canvass up, and spread it: if that will not do, I will haul aft the main-sheet, and put the helm a-lee; then send hands out to the sprit-sail yard with hammocks and gaskets to stop the sprit-sail (called balancing) within the lee clue-line block; and loose the lee yard-arm; then haul aft the sheet, clap the helm hard a-weather, ease off the main-sheet, round in the weather-brace, gather aft the other sheet, haul the main tack on board; when she is before the wind, square the sprit-sail yard, clue the sail up and furl it, ease the helm down a-lee, brace the yards up, haul the main-sheet aft, bowse the bow-line up, lash the helm three parts a-lee, and she will lay-to as before.

Q. Suppose she will not veer after all you have done?

A. I will loose the goose-wings of the fore-sail; if that will not do, set the fore-sail, and veer her as under courses, or haul the main-sail up; if by hauling the main-sail up, and furling it, she does not veer, lower down the mizen yard; if that will not do, lower down the cross-jack-yard and mizen top-mast; if that will not do, cut away the mizen-mast.

Q. It blows hard, and you split your top-sail?

A. I would let go the bow-line, haul in the weather-brace, and lower away the halyards; clue up the lee sheet, haul up the bunt-lines, start the weather sheet, belay the clue-lines and bunt-lines, unbend the sail, and bend another; then either furl or set it, as circumstances require.

Q. You are lying-to in a hard gale of wind, and split your main-sail?

A. I will haul it up carefully, unbend the sail, and bend another; get on board the main tack, and haul aft the sheet; when the sail is set, get a tackle on the weather-leach to secure the tack, and a preventer sheet; but in small ships they get the lee tack aft for a preventer sheet.

Q. Suppose you are on a wind, and let the Ship come up in the wind, and are all aback, what will you do?

A. I will box her off; and suppose she will not box off, I will haul the mizen up, let go the main and main-top bow-lines, the lee-main and main-top-sail braces, and lay all square abaft; put the helm to leeward, if she has stern-way; when the wind is abaft the beam, shift the helm; and, as she gets head-way, haul in a little of the after-braces, haul the mizen out, brace up sharp abaft, and haul the bôw-lines; and then I am on the same tack as before.

Q. Suppose you are on a wind, close upon the land, and standing on must run on shore, and you can clear the land on the other tack; but it blows hard, and a head swell, that she will not stay; and, should you veer, you would be on shore; how would you get upon the other tack?

A. I would club-haul her; this is done by putting the helm a-lee, and letting go the lee anchor, and bringing her head up to wind; then cut the cable, and haul about the after-sails; and when they are full, brace about the head-sails, haul on board the fore-tack, and brace up the other way.

Q. If by accident your Ship is brought by the lee, what would you do?

A. When a Ship is brought by the lee, it is commonly occasioned by a large sea, and by the neglect of the helm's-man. When the wind is two or three points on the quarter, the Ship taking a yaw brings the wind on the other side, and lays the sails all dead to the mast; as the yards are braced up, she then having little way, and the helm being of little service. I would therefore brace about the head-sails the other way, and keep the main-top-sail shivering; when she gathers way, and brings the wind aft again, raise the fore-tack, and square the head-sails; trim the sails as they were before, and bring her to her course again.

N. B. It is dangerous to bring a Ship by the lee in a gale of wind, for she lying entirely against the sea, her sails can be of little service till they are braced about.

Q. Suppose you are on a lee shore, and had neither room to veer or stay, nor any anchoring ground, how would you put the Ship's head round the other way?

A. I would put my helm hard a-lee; when she comes head to wind, raise the fore and main tacks directly, make a run with my weather braces, and lay all aback at once; then haul forwards my lee-tacks and bow-lines as far as I can, that the Ship may fall round on her heel; and when the main-sail begins to shiver, I would haul it up, fill my head sails, and shift the helm hard a-weather: when the wind comes on the other quarter, haul on board the main tack, and bring her close to the wind.

Q. Suppose you are on a lee shore, and could clear the danger on the other tack, although not room to veer and a sea on, she will not stay, and you had good anchoring ground, what would you do?

A. When I saw the danger, I would take a good hawser, and lead it out of one of the quarter ports, and bend it to the anchor to leeward; the other part I would bring to the capstan, ship the bars, and when I clap the helm a-lee, and as soon as the wind is out of the main-sail, haul it up, let go the anchor, and heave on the spring to cast her, because the cable should not check her. When she comes head to wind, brace about the main-yard, haul on board the tack, and cut away the cable and spring; when the main-sail fills, set the fore-sail, haul on board the tack, and trim her to the wind.

Q. Suppose it blows hard, you cannot carry your courses, night coming on, and it is likely to blow harder, what will you do?

A. I will haul the fore-sail up and furl it, balance the mizen, haul it out to keep her to, then haul up the weather main clue-garnet and bunt-line, then the lee clue-garnet bunt-lines and leach-lines, square the yards, and get strops round the mast above the booms to hook the yard tackles to for rolling tackles, then reef the sail; when reefed, haul on board the tack, get aft the sheet handsomely, bowse up the bow-line, haul taut the weather braces, and haul up the mizen.

Q. Suppose you are turning over the Flats with your top-sails and fore sail; you endeavour to put about, but she will not stay; there is a sand a-head, within a cable's length of you; what will you do?

A. I will heave all aback, and when she has stern way shift the helm; when she has paid well off, brace about the head-sails, and shiver the after-sails; then she will veer round and stand off.

Q. You are in a gale of wind, and split your fore-course, what will you do?

A. I'll man the weather fore clue-garnet, bunt-lines and leach-lines, ease off the fore-tack, and, when clued up, man the lee clue-garnet, and haul it close up; then let go the lee-brace, haul taut the lifts and braces, send hands to unbend the sail; when another is bent, and I want to set it, I will haul on board the fore-tack, and haul aft the fore-sheet, brace the yard up, and haul the bow-line.

Q. It blows hard, and you want to reef your courses, how would you proceed?

A. As above; only that, when clued up, I would reef instead of unbend.

Q. Suppose you are in chase of an enemy's Ship of war, upon a wind, with all your sails set; she is right a-head; on which side will you engage her?

A. I will engage her to leeward, by reason she cannot put away before the wind; and if there is any thing of a sea, she may not be able to fight her lower tier of guns. If light breezes and hot weather, it would be better to engage to windward, to let them receive the smoke and heat of the fire.

Q. You are chasing from the wind, and carry away your main-top-mast, how will you proceed?

A. I would haul up the main-sail, and send hands up into the top with a rope or hawser, to clap on that part of the mast that hangs down; then cut the lanyards of the main-top-mast shrouds, and lower away; cast off the hawser, reeve it to send the stump down, clear away the rigging, unsling the main-yard, get the fore-tackle on it, and bowse and forward the yard; then lower the stump upon deck, and get the spare top-mast ready for the cross-trees; clap the hawser on, and sway it up high enough for the rigging.

Q. You are lying-to in a hard gale of wind under your main course, you carry away your main-mast, how will you proceed to clear the wreck?

A. I will clap my helm a-weather, brace my fore and fore-top-sail yards full, then call all hands to get pole-axes, &c. to clear away the rigging.

Q. Why will you put the Ship before the wind?

A. Because the mast will go a-stern clear of the rudder, and prevent its damaging the Ship.

Q. Suppose you were to carry away your bowsprit, what would you do?

A. I would immediately veer Ship, and keep her before the wind; and then, for the security of the fore-mast, I would carry forward the fore-runners and tackles, and bowse them well taut, till I can get a hawser or sufficient rope, and clinch it round the mast head, and secure it to the bits of the forecastle or the cat-heads; then take the best spar I have, and make a jury bowsprit of it.

Q. Having a fair wind, how will you set your fore-top-mast studding-sail on the larboard side?

A. First haul taut the truss tackles, and bowse the fore-yard close to; then haul taut the larboard fore-lift, and starboard fore-top-sail clue-line; on board his Majesty's Ships the top-burtons are on the top-sail yards to keep them square when studding-sails are set (the top-sails, lifts, and clue-lines not thought of); the fore-top men down on the fore-yard, and rig out the larboard studding-sail boom, first sending down the studding-sail tack and outer halyards up to the fore-top-sail larboard yard-arm; and reef the halyards; send them down, and bend them; the tack being bent and all ready, man the halyards and hoist away, haul out the tack, &c. If the wind is on the beam or quartering, set it abaft the top-sail; if right aft, before the top-sail (which is done by a man standing on the fore-yard-arm, with the leach of the studding-sail in his hands).

Q. Suppose you are in an engagement, and your main-top-mast stay is shot away, how will you secure your mast?

A. I will send my shifting back-stay forward by the main-top-mast stay-sail halyards, and reeve it through a block abaft the fore-mast-head, bowse it taut, and that will secure the mast.

Q. Your Ship comes-to against her helm, what will you do?

A. I will haul my mizen up, and shiver the after-sails.

Q. She comes-to yet; if she stays, she will be on board some other Ship?

A. I'll let go the lee-fore and fore-top-sail braces, raise the fore-tack and let go the bow-lines, haul in the weather-braces, and box her off.

Q. How do you splice your cables?

A. I will put the whole strands of the best or small bower cables twice each way, and point each strand with a tail of three fathoms each, then seize them with quarter and end seizing to make them lie snug, which is the readiest way for clearing the hawse; they being soon spliced and unspliced when pointed.

Q. How would you mark the lead line?

A. Black leather at 2 and 3 fathoms, white at 5, red at 7, black at 10, white at 13 (some seamen use black at 10 and 13), white at 15 as at 5, red at 17 as at 7, two knots at 20 fathoms, and so on, an additional knot at every 10 fathoms, with a single knot between each 10 fathoms, to mark the line at every 5 fathoms.

Q. You are sent down in the dark for a top-sail, how do you know a main-sail from a fore-sail, or a main-top-sail from a fore-top-sail.

A. If it has three bow-line cringles, it is a main-sail; if it has but two, it is a fore-sail; if it is marled abaft the foot rope, it is a main-sail, if before it is a fore-sail; if a main-top-sail, it has four bow-line cringles, if a fore-top-sail, but three: all top-sails are marled to the rope, because the foot rope is served.

Q. The sheers are along-side, how do you get them in?

A. Par-buckle them in with their heads aft on the poop, and get the fore and main-runners on them for guys; lash on two four-fold blocks, reeve the masting-falls, get girt-lines on the head of the sheers to steady the mast-head, put heel-lashings on the sheers, with good oak planks under them, to transport them forward on; lash one of the four-fold blocks forward to the stem, and bring the fall to the capstan; heave the sheers high enough; when done, I'll take forward two runners and tackles to assist the sheers, take the mizen-mast first in, then raise the sheers erect, take in the main-mast, bowse the heels of the sheers forward, and keep them upright to take in the fore-mast.

Q. How do you rig a lower-mast?

A. I will lash on the girt-line blocks, put on the bolsters, parcel and tar them, put over the runner and tackle-pendants, then the foremost of the starboard-shrouds, then the larboard, and so on; then the stay and spring-stay; seize in the dead-eyes for the shrouds, and the hearts for the stay; reeve the lanyards, set up the rigging, get the top over head, and bolt it; rattle down the shrouds, and seize on the cat-harpin-legs; hook the futtock-shrouds, and hitch them; seize down the ends, lash the hanging jeer-blocks under the top, with the strops under the stays, lead up and lash-to the mast-head, get the cap into the top for the head of the top-mast, and lash the blocks on for the main-lifts.

Q. How do you get a top and cap over?

A. Make fast a girt-line block on each side of the mast-head, reeve the girt-lines, and pass them under the top, and make them fast to the after par of the top; stop them to the bolt-holes in the middle and fore part of the top; then sway away: when high enough, cut the upper stops, having a guy on the after part of the top-brim, and the top will fall over the mast-head; then lower away, and put it in its birth; haul up the guy, and bolt it; lay the cap steady over the trussel-trees for the top-mast-head to receive it; when the top-mast-head is through it, lash the cap to the top-mast-head, sway away the top-mast till high enough, then place the cap on the mast-head, and drive it down.

Q. How do you rig a main-top-mast?

A. I will tar the mast-head, get the cross-trees over, fix the bolsters, and parcel them; put over the burton-pendants, then the shrouds, breast-back-stay, proper and spring-stay, and cap; sway up the mast and fid it, seize in the dead-eyes, stay the mast, set up the shrouds, rattle them down, and lash the bollock-blocks to the mast-head.

Q. How do you rig a top-gallant-mast?

A. I will send down the top-rope, reeve it through the sheeve-hole, and make it fast round the hounds of the mast and standing part of the rope, leaving enough end to make fast to the cap, which done, sway away; when the head is through the cap, make fast the spare end or standing part of the top-rope to the cap, cut the seizing, clap on the grommet, then the shrouds, back-stays, and stay; sway up the mast, fid it, and set the rigging up.

Q. How do you rig a bowsprit?

A. I will lash on the collar for the fore-stay, the bob-stays, and bowsprit shrouds; then the collar for the spring-stay, then the block for the top-mast-stay, fix the man-rope, gammon the bowsprit, and set the bob stays and shrouds up.

Q. How do you rig a jib-boom?

A. I will put over the jib-traveller, horses, and guys, the top-gallant stay-block, and lash on the blocks for the top-gallant bowlines, and jib down-haul block to the traveller.

Q. How do you rig a lower yard?

A. I will get the yard athwart the gunwales; lash the jeers, quarter clue-garnets, bunt-lines, leach-lines, and slab-line blocks; then put over the yard-arms, the horses, brace-pendants, the yard-tackle-pendants, then the top-sail sheet and lift-blocks; reeve the jeers, braces, lifts, and yard-tackle-falls; truss parrels, sway the yard up, and haul all taut.

Q. How do you rig a fore-topsail yard?

A. I will reeve a hawser, for a top-rope, through the bollock-block, and send it down; and, having put over the horses, make the top-rope fast to the middle of the yard, stopping it to the yard-arm; sway it up above the top, put over the brace-pendants and lift-blocks, reeve the lifts and braces, cut the yard-arm seizing, and cross the yard; lash the tye, bunt-line, and clue-line blocks; reeve the tye and halyards, sway it above the cap, and parrel it; then reeve the clue-lines, bunt-lines, and reef-tackles.

Q. How do you rig a top-gallant yard?

A. I will seize the clue-line blocks on, put the horses over the yard-arms, sway it up to the cap, and rig the yard-arms, by putting on the brace-pendants and lifts; then cross the yard, and parrel it.

Q. You have lost your rudder at sea, what method will you take to steer the Ship?

A. I will take a large spar, or part of a top-mast, and cut it flat, in the form of a stern-post; bore holes, at proper distances, in that part which is to be the fore part of the preventer, or additional stern-post; then take the thickest plank I have on board, and make it as near as I can into the form of a rudder; bore holes, at proper distances, in the fore part of it, and in the after part of the preventer stern-post, to correspond with each other; and reeve rope grommets through those holes in the rudder and after part of the stern-post for the rudder to play upon.

Through the preventer stern-post reeve guys, and at the fore part of them fix tackles, and then put the machine over-board; when I get it in proper position, or in a line with the Ship's stern-post, lash the upper part of the preventer-post to the upper part of the Ship's stern-post, then hook tackles at or near the main-chains, and bowse taut on the guys to confine it to the lower part of the preventer stern-post: having holes bored through the preventer and proper stern-post, I will run an iron bolt through both, taking care not to touch the rudder, which will prevent the false stern-post from rising up or falling down.

By the guys on the after part of the rudder, and tackles fixed to them, I may steer the Ship. I must take care to bowse taut the tackles on the preventer stern-post, to keep it close to the proper stern-post.

Q. Your Ship is leaky, you cannot keep her free by the pumps, what will you do?

A. I will take a spare top-sail, or some other sail, and spread it upon the deck, cover it all over with oakum, and bind it to the sail with a needle and twine in several places, to keep it fast to the sail; then take a hawser, and cut it into proper lengths, to go under the Ship's bottom, and come in over the gunnel; put these hawsers about four feet distant under the sail, and make them fast with their middle to the middle of the sails, each leach beginning at the head, and leaving off at the clues: then put the sail overboard, keeping the oakum side to the Ship's bottom, and haul up the ends of the hawsers on the other side by a hauling line which I have swept the Ship with, numbering each end fore and aft; then ease away on the hawser's ends on that side I have put the sail over, and keep hauling at the same time on the hawser's ends on the opposite side when the sail is properly down, which is known by marking the hawser; I will then clap on tackles, and bowse all taut, keeping the sail close to the Ship's bottom; the oakum will then be drawn in, and stop the leak. The sail may be covered with horse dung, or any filth I have on board, which will be drawn in, and stop the leak.

Q. Your anchors are along-side, how would you get them in?

A. If my sheet-anchor is uppermost, I would overhaul my fore and main tackles, have a good pair of gun or anchor slings, and clap it on about the crown of the anchor, passing the end to the inner bill, and seize it well with a good bill lashing; then hook on the main tackle, clap on another pair of slings on the shank of the anchor, close to the stock, and hook on the fore tackle, having at the same time a good loof tackle from forward on to the ring of the anchor, to keep it from going too far aft, and another from the upper part of the stock, hooked on in board, abreast of the anchor; when all is ready, hoist away the fore and main tackles, being careful to keep a shoe between the fluke of the anchor and the Ship's side, and occasionally bousing-to the stock-tackle until high enough; then secure it well with the stopper and shank-painter; when done, drop the craft under the bows, and hoist the others up to the cat-heads.

Q. How do you coil your cables?

A. The same way they are bitted, or passed round the windlass; that is, the best bower against the Sun, and the small bower with the Sun; supposing the best bower to be on the larboard side, and the small bower on the starboard.

Q. Coming into soundings from a long voyage, how would you prepare for going into port and anchoring?

A. I would order the cables to be bent thus: get their ends up, reeve, hawse, and ring ropes to haul them out; the fore-castle men to clinch them, and quarter-master to clap the bends on; reeve the runners and tackles, unstow the anchors, bend the buoy and buoy-ropes, single the stoppers and shank painters, bit the bower-cables with a long range, have the dog-stoppers to pass, see the tiers clear, have hand-leads and lines in the chains, send down the top-ropes, reeve the top tackle-falls, unsling the lower-yards; when the cables are bent, &c. clap the hawse-bucklers on.

Q. Suppose the wind northerly, and you are in a Ship's hawse in the Downs, what would you do?

A. I would wait until the Ship tends to windward, and heave up my anchor as she is tending.

Q. You are at anchor in the Downs with the wind S.W. and are ordered for Spithead; at what time of the tide would you unmoor?

A. At half-flood, in order to be ready to weigh at high-water; and I would cast her head in shore, as I should then have more of the ebb-tide in my favour.

Q. You are coming into the Downs with the wind from the westward, and it blows hard; which way would you lay your Ship's head?

A. I would come-to with the Ship's head to the eastward, if I intended to let go my best bower; but if the small bower, to the westward, in order to keep my cables clear of the cut-water.

Q. You are moored at Spithead, and ordered to sail to the westward; what time of the tide would you unmoor?

A. At the beginning of the flood, taking up my small bower first.

Q. How would you moor at Spithead?

A. With my best bower to the S.E. and small bower to the N.W.

Q. The wind is at S.W., it blows hard, you part all your cables in the Downs; what would you do?

A. I would cut away the ends of the cables from the bows, hoist the fore-stay-sail, and wear Ship as soon as possible; when done, I would bring the South Foreland upper light to bear S. W. ½ W. then steering N. E. ½ E. I would psss to the Westward of the Gull Lights, and as soon as the Goodwin Lights bore E.S.E. haul out for them; or, when the North Foreland Light bore W.N.W. would steer E.S.E. and heave to in 18, 19, or 20 fathoms, taking care, in running through the stream, to stand to the Brake no nearer than 7 fathoms, nor to the Goodwin than 11 fathoms.

Q. What are the dangers between the Lizard and the Rame Head?

A. The Udder Rock, it lies 4½. miles W. ¾ N. from Loo Island, and has nine feet on it.

Q. What are the dangers off the Start?

A. The Skerrie rocks; they lie one mile off, E. ¼ N. with only nine feet water on them, and five fathoms close to them. I would clear them by keeping the Bolt Head open of Praul Point.

Q. What is the leading mark into Portland Roads, in order to clear the east end of the Shambles? *

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* Two buoys have been recently placed on the Shambles, viz. a red buoy on the east end, and a black one on the west end.

A. Wyke Church well open of the north east point of Portland.

Q. What are the marks for anchoring in Portland Roads?

A. Portland Castle S.W.—The north east point of Portland S. by W.; and Weymouth or Sandyfoot Castle, N. N. W. ¾ W. in 6 or 7 fathoms.

Q. Coming from the westward, in what latitude would you endeavour to make the channel?

A. In latitude 49° 25′ N. because if I come to the northward of that latitude, I should get to the northward of Scilly, in consequence of the indraft of St. George's Channel, which is to be met with full 15 leagues to the southward and westward of Scilly; the tide running 9 hours to the northward, and only 3 to the southward.

Q. In thick weather how would you know when you are to the northward of Scilly?

A. By having from 45 to 50 fathoms oozy bottom.

Q. What variation is there at the entrance of the British Channel?

A. Two points and a half westerly.

Q. What soundings do you get in the fair way of the Channel?

A. White sand, small yellow stones with black specks, and broken shells.

Q. What is the Channel Course?

A. East and by South, and West and by North.

Q. How do you know when you are on the French Coast in thick weather?

A. By having deep water, with large stones and red sand.

Q. What buoys are there in the Downs and Gull Stream?

A. One buoy on the Gull, white; one on the Elbow, white; one on the north Brake Head, red; one on the south Brake Head, black; and one on the Fork, chequered black and white.* There are also two light vessels; one at the North Sand Head, with three lights, in a triangular form; and one in the Gull Stream, near the Bunt Head, with two lights, placed horizontally.

Q. What are the marks for being clear of the South Sand Head?

A. Upper Deal Church on with Walmer Castle, bearing N. ¾ W. or the two lights on the South Foreland in one, bearing W. ¾ N.

Q. What is the best mark for large Ships to anchor in the Downs?

A. Upper Deal Mill and Deal Castle in one, in 9 or 10 fathoms.

Q. In proceeding from the Downs to Spithead, what are the dangers?

A. The South Sand Head, the Varne, Ridge, Roar, Swallow, Stephenson's Shoal, Royal Sovereign, Horse of Willingdon, Pevensay, East Barrow Head Owers, Horse, and Dean.

Q. What lights are there on the South Coast of England?

A. On the Galloper, a vessel with two lights, horizontal.—North Foreland, one.—North Sand Head, a vessel with three, in a triangular form.—Gull stream, a vessel with two, placed horizontally.—South Foreland, two, bearing W. ¾ N.—Dungeness, one.—On the South East end of the Owers, a vessel with one.—Nab Rock, a vessel with two, placed at different heights.—† Hurst Point, two, bearing N. E. by E. ½ E.—Needles Point, one.—Bill of Portland, two, bearing N. N. W. ¼ W.—Plymouth Sound, a vessel with two, placed horizontally.—Eddystone, one.—Lizard Point, two, bearing East and West.—Long Ships, one.—St. Agnes, on Scilly Island, one, revolving, in order to distinguish it from the Long Ships.

Q. What lights are there on the North Coast of France?

A. Ushant, one.—Caskets, three, in a triangular form.—Cape Frehel one.—Granville, one.—Cape Barfleur, one.—Cape La Heve, two, bearing N. N. E.—Cape Lailly, one.—Dieppe, one.—St. Valery, one.

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* A red beacon buoy, with a staff and vane, has been lately placed on the South Sand Head.

† A light is now placed on South Sea Castle.

Q. What is the variation in the Downs?

A. Two points and a quarter westerly.

Q. How would you anchor in Torbay?

A. Bring the Berry Head to bear South; and Brixham Church on with he Pier Head, in 6 or 7 fathoms.

Q. How near would you stand into, and off from, the principal Headlands in the Channel.

A.

	Into	Off		Into	Off
Scilly	65 fms.	69 fms.	Dunnose	25 fms.	35 fms.
Lizard	45 ——	53 ——	Owers	22 ——	30 ——
Eddystone	42 ——	51 ——	Beachy Head	18 ——	28 ——
Start	32 ——	47 ——	Dungeness	12 ——	20 ——
Portland	30 ——	36 ——	South Foreland	10 ——	18 ——

Q. What is the mark for going between the Race and the Shambles in the night?

A. The two lights on Portland in one,* bearing N. N. W. ¼ W.—I would run in with this mark until the land shuts in the new light-house, then steer N. N. E.

Q. What are the marks for sailing into Plymouth Sound?

A. Plymouth New Church on with the red beacon on the Hoa N. E by E. ½ E. As soon as Mount Batten Tower bears E. N. E. I would steer for it, or when the Shagstone comes on with the Mewstone, haul in for anchorage. The new light vessel is always to be kept on the starboard hand, which will take me clear of the Breakwater, and to the westward of the Panther and Knap In entering the Sound I would round Penlee point in 8 or 7 fathoms.

Q. What are the anchoring marks in Plymouth Sound?

A. Drake's Island bearing N. W. by N. with Mount Edgecumbe House open to the southward of it. Mount Batten N. E. by N. and the Whitby Hedge S. E. by E. or end on; in 6 or 7 fathoms.

Q. What are the dangers near the Land's End?

A. The Runnel Stone,† Wolf Rock, Long Ships, and the Seven Stones.

Q. Which is the narrowest part of the Channel?

A. Between Portland and the Casketts.

Q. If you have 75 fathoms red sand and gravel, how does Scilly bear from you?

A. About N. W.

Q. In coming from the eastward, how near would you stand to the Ower's light?

A. About two miles; the light bearing N. W. by W.

Q. In coming from the westward, and bound to Spithead, what are the buoys on the larboard hand?

A. One on the south-east end of the Princessa, black; North West End, white; Bembridge or Betty's Ledge, black; Knab Rock, red; (the new light lies east from this buoy about ¼ of a mile.) Warner, white; Noman's Land, white; and two on the Sturbridge, white.

Q. What is the mark for the buoy on Noman's Land!

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* The upper light is revolving, and the lower one fixed.

† A red buoy is now placed W. by S. 26 fathoms from the Runnel Stone Rock

A. Ashey down beacon on the N. W. angle of a triangular field to the westward of the Salthouses, and the gap in the fir trees in Postdown Hill on with St. John's Chapel at Portsea.

Q. What is the leading mark through the Needles?

A. Pilewell Bath, which is a Cupola Building, on with Hurst Castle: at night, the two lights on Hurst Point in one.

Q. How do you know when you are clear of the west end of the Owers?

A. By Medmerry House being in one with Chichester Church, or St. Rook's Hill, bearing N. E. ¼ N.: and when Dunnose bears W. N. W. I would steer N. W. by N. for Spithead, passing to the eastward of the light vessel.

Q. What is your mark for being abreast of the Owers?

A. Selsey Bill bearing North.

Q. How near would you stand to the South Foreland in the night?

A. I would keep the lights in sight above the land.

Q. What is the mark for being clear of the east end of the Owers?

A. Pegham Grove, Chichester Church, and the White Way on Bow Hill, in one, bearing about North.

Q. What is the mark for clearing the Horse of Willingdon, and Royal Sovereign Shoals?

A. Keep the Seven Cliffs of Beachy in sight.

Q. What is the mark for anchoring at St. Helens?

A. Ashey Down Mark on with the White Sea Mark, in 7 or 8 fathoms.

Q. In coming into the Channel from the westward in thick weather, how do you know if you are too far to the southward or northward of the Fairway?

A. When I get red sand and coarse gravel, I am near the coast of France; if mud and oozy bottom, in the stream, or to the northward of Scilly; but if white sand, with black specks and small shells, I am then in the fair way of the Channel.

Q. What are the bearings and distances of the Varne and Ridge from the Coast?

A. The east end of the Varne lies S. S. W. ½ W. 8 miles from the South Foreland; south by west, 7 miles, from Dover Castle; S. E. ½ S. 7 miles from Folkstone. The west end S. W. ¾ S. 11 miles from Dover Castle, South 8 miles from Folkstone Church, and E. by S. 11 miles and a half from Dungeness. It has 7 fathoms on the west end, 4 on the east, and 2½ on the middle. The east end of the Ridge lies S. by W. 12 miles from Dover Castle, and W. N. W. from Calais Cliff; the west end lies S. E. near 13 miles from Dungeness, and S. S. W. ¾ W. 19 miles from Dover Castle. On the west end is a black buoy in 4 fathoms; on the east end a red buoy in 3½ fathoms; and about 2¼ miles north eastward from the black buoy is a swinging beacon in 3 fathoms. Between the Varne and Ridge there are from 18 to 20 fathoms.

Q. You are bound to Spithead and the buoys are all gone.

A. I would keep Ashey down Sea Mark, on the Isle of Wight, in sight above the trees; and that will carry me clear of all the dangers. I would stand to the Warner into 12 fathoms, to the Dean in 9 or 10, to the Horse 11, and to the Noman's Land 18 fathoms; the moment the water shoals, near Noman's Land, I would tack to the eastward, it being steep to.

Q. What is the mark for being clear of the West End of Stephenson's Shoal?

A. Lydd Church and Mill in one bearing N. E. ½ E.

Q. How would you anchor under Dungeness?

A. I would bring it to bear S. W. by W. or W. S. W., keeping the Hope Land open of Dover, in 10, 11, or 12 fathoms.

Q. How would you anchor at Spithead?

A. I would bring South Sea Castle to bear N. E. by E., and the Kicker Point N. W. and anchor in 14 fathoms.

Q. What is the mark for the South-east buoy of the Dean?

A. Ashey Down mark on with the southernmost of the two clumps of trees at the Priory House, on the Isle of Wight, and the Spire of Portsmouth Church, a sail's breadth open to the eastward of South Sea Castle.

Q. What is the mark for going into Spithead?

A. The Spire of Portsmouth Church, North a little westerly, or Kicker Gill and Fort Monkton in one.

Q. What are the marks for the buoy on Bembridge Ledge?

A. The New Inn on with Red Cliff Point, bearing N W ½ W. and the small chalk pit on the high land of Dunnose, just open to the Southward of Culver Cliff, bearing W. by S.

Q. You are off Beachy Head in a dark night, and in a strong gale of wind at N. E. and bound to Spithead?

A. I would lie-to with the Ship's Head to the N. N. W. till morning, keeping the lead frequently going; she would then drift a channel course about two knots an hour, (allowing her to loose on the ebb what she would gain on the flood,) and be in the fair way in the morning.

Q. Being abreast of the Isle of Wight, and running for the Downs with a heavy gale of wind at S. W. how would you act?

A. Get the top-gallant yards and masts down, and run under the fore-sail; see all the cables clear. When you round the South Foreland (keeping the lights in sight) and are in the proper anchorage, haul the fore-sail up and haul the mizen out, hard a starboard the helm, and when the Ship comes head to wind, let go your best bower anchor and veer away.

Q. Suppose you part your best bower?

A. Let go the small one.

Q. You part your small bower?

A. Let go the sheet.

Q. You part the sheet?

A. Veer Ship and run through the Gull Stream.

Q. Suppose the Ship will not veer, the ends of the cables being out, and hooking the bottom?

A. Cut the cables from the bows, and when through the Gull Stream, and clear of the North Sand Head, stand with the Head to the eastward, and heave-to till day-light,

Q. How do you know the different Head-lands in the Channel?

A. The Lizard is middling high land, on which there are two light houses, and several churches.—The Ramehead is even and round, on which stands a large barn.—The Start Point is quite ragged like a Cock's Comb.—The Bill of Portland is bluff land, and appears like an Island; it has two light-houses on it.—St. Aldan's Head is high land; it has an Old Castle, with several large seats on it.—Peverel Point slopes to the S. E. and is smooth.—The Isle of Wight is high, and has a remarkable sea mark on it, called Ashey Down Tower.—To the westward of Beachy Head are seven very remarkable White Cliffs; the land is high and bluff.

Q. What are the Bearings and Distances of the principal Head-lands, &c. in the Channel?

	Bearings by Compass.	*Distances in Leagues.*
A. North Foreland to the South Foreland	SW¾S.	5
South Foreland to the Dungeness	WSW½W.	7
Dungeness to Beachy Head	W¼N.	10
Beachy Head to Selsea Bill	NWbyW¾W.	13
Beachy Head to Dunnose	WNW¾W.	19
The east end of the Owers to Dunnose	WNW¾W.	7
St. Catherine's Point to St. Aldan's Head	WNW.	10
St. Catherine's Point to Bill of Portland	WNW¼W.	15
Bill of Portland to Berry Head	WNW¾W.	13
Bill of Portland to the Start	W¾N.	16
Bolt Head to the Rame Head	NW¼N.	6
Bolt Head to the Eddystone	WNW.	6
Bolt Head to the Lizard	WbyN.	18
Rame Head to the Lizard	W¼S.	14
Lizard to the Runnel Stone	NW½W.	6
Lizard to the Wolf Rock	NWbyW¾W.	8
Land's End to the Wolf Rock	SW½W.	3
Land's End to St. Agues' Light	W¼N.	9
Land's End to the Seven Stones	WNW.	5

N. B. The bearings in the foregoing directions are all by Compass.

Q. What are the times of High Water on the Shore, and till what time does the stream run in the Offing, on full and change days, at the principal Head Lands, &c. in the Channel?

	H.W. on the Shore.		*Stream in the Offing.*	
A. Deal and the Downs	11*h.*	15*m.*	2*h.*	45*m.*
South Foreland	11	0	2	45
Dungeness	10	30	1	45
Beachey Head	10	15	12	0
Owers and Looe Stream	11	0	11	0
In the Looe, the flood stream runs till near ten o'clock, and then runs westward six hours.				
St. Helen's or Brading Harbour	11	0		
Portsmouth Harbour	11	30		
At Spithead the flood runs till and ebbs 7 hours.	9	30		
At the Needles the flood runs in till	10	0		
Dunnose			10	45
Cowes	11	15		
Needles	8	56	10	30
Portland Road and Weymouth	6	30		
Bill of Portland	7	15	10	15
Torbay, Dartmouth, &c.	6	0	9	0
Plymouth Sound	5	30		
Eddystone	5	15	8	25
Falmouth	5	15		
Lizard	4	55	7	42
Mount's Bay	4	40		
Wolf Rock, and Long Ships	4	30	7	30
St. Mary's (Scilly)	4	40	6	40

Q. When bound to the Cape, or East Indies, in what longitude would you endeavour to cross the Equator?

A. From 18° to 22° West.

Q. What is the variation of the Compass, at that part of the Equator?

A. About three quarters of a point Westerly.

Q. Being bound to St. Helena outward, to which route would you give the preference, the Eastern or Western?

A. That would depend on the season of the year:—I would prefer going to the Eastward of the Island, during the months of November, December, January, February, and March.

Q. Why so?

A. Because, during that season, the N. E. Trade carries me within 2 or 3 degrees of the Equator; and then generally veers to East, or E. by S. where it most frequently remains steady in those months; consequently, by having the S. E. Trade well to the Eastward, I would shape my course to windward of the Island.

Q. Suppose you go the Western passage, how far would you run to the Southward?

A. To about 28 or 29 degrees of Latitude, and then tack.

Q. In what latitude would you endeavour to round the Cape of Good Hope outward-bound, and also in June or July, homeward-bound?

A. Outward-bound I would endeavour to round it between 37 and 38 degrees South,—and homeward from 35 to 35½ degrees, for the purpose of availing myself of the Current.

Q. What dangers are there in the Mozambique Channel?

A. Bassas de India, Europa Rocks, Juan de Nova, Coffin Island, and Chesterfield Shoal.

Q. In sailing through the Mozambique Channel, how would you shape your course?

A. As near mid-channel as possible, because, the Monsoon blows more regular there, than along the coast; and by taking that route, I should avoid all the dangers except Basses de India, and Europa Rocks, which I would pass to the Westward with great caution, steering between Juan de Nova, and the main, direct for Mohilla, or Comoro.

Q. What are the dangers in the middle passage?

A. St. Brandon Shoal, Cargados Bank, and the Bank Saya de Malha, all very imperfectly known.

Q. How are the currents in this passage?

A. Very changeable, particularly between the Equator, and the Northern limit of the trade wind;—I should therefore act with great caution, particulary during the night.

Q. How would you steer from Cape Ambre to Bombay?

A. About N. ½ E. is the safest track, till clear of the small Islands which lie N. E. and N. W. of the Cape; having passed them, I would steer a direct course N. E. for Bombay.

Q. In what latitude would you endeavour to make Bombay Harbour?

A. Latitude 18° 50′ N., which would carry me between Old Woman's Island and Kenery Island.

Q. What are the dangers going into Bombay?

A. Tull Reef; S. E. and S. W. Prongs; the reef surrounding Old Woman's Island; Sunken Rocks; and Middle Ground.

Q. What water is there round the aforesaid dangers?

A. Tull Reef has 5½ fathoms to the Westward of it, and 3 fathoms to the Southward; S. E. and S. W. Prongs has 4, 5, and 6 fathoms; the reef surrounding Old Woman's Island, from 4, 3½, and 2 fathoms; Sunken Rocks 5 fathoms, and Middle Ground only 4 fathoms.

Q. What is the mark for being clear of the Prongs to the Southward?

A. Funnel Hill in one with the North part of the Great Caranja Hill; or keeping it to bear E. by N.

Q. Suppose you cannot see Funnel Hill?

A. I would bring the North part of Great Caranja Hill to bear E. ¾ N. and run on that course until I open the harbour.

Q. What are the marks for clearing the S. E. Prong?

A. Bombay Church in one with the Oyster Rock.

Q. What mark have you for clearing the S. W. Prong?

A. Malabar Point N. by E. ¼ E. clears me of them.

Q. What is the mark for clearing the Sunken Rocks?

A. Mazagon House a sail's breadth open to the Eastward of the N. E. Bastion of Bombay Fort.

Q. Suppose you cannot see Mazagon House?

A. I would then bring the N. E. Bastion of Bombay Fort to bear North, or N. ½ E.; and run in with that bearing, which would carry me clear of the Sunken Rocks and Middle Ground.

Q. What are your anchoring marks in Bombay Harbour?

A. Brab-tree in the Castle, and the Flagstaff, in one, in 6 or 7 fathoms.

Q. What course ought you to steer down the Malabar Coast during the S W. Monsoon?

A. S. S. E. an allowance being made for the great W. S. W. swell, of ½ or ¾ of a point, as may be deemed necessary.

Q. How near would you stand to the land?

A. No nearer than 15 or 16 fathoms, the weather being generally very hazy during the S. W. Monsoon.

Q. What soundings would you endeavour to keep in down the Malabar Coast?

A. In 40, 45, and 50 fathoms, until I reached the Latitude 12° 0′ or 12° 30′ N.

Q. What dangers do you expect to meet with to the Eastward of Ceylon?

A. The Great and Little Basses, which are very dangerous reefs; they are elevated a few feet above the water's edge, and project a considerable distance below its surface.

Q. How near would you approach them?

A. Great Basses from 25 to 35 fathoms, and Little Basses from 30 to 40 fathoms.

Q. Where would you make the Land being bound to Madras?

A. About Friars Hood in Ceylon, in lat. 7° 17′ N. in the S. W. Monsoon; but, during the N. E. Monsoon, I would endeavour to make Point Divy, in lat. 16° 00′ N., and then Pulicate Reef, in lat. 13° 25′ N.

Q. How would you anchor in Madras Roads?

A. With the Flagstaff and Cupola of the Town Clock in one, bearing W. N. W.; St. Thomas's Mount S. W. ½ W.; and the high Black Pagoda W. S. W.; in 10 fathoms, off shore about two miles, where I shall have good anchorage; but more Northerly the ground is foul.

EXPLANATION AND USE

OF THE

TABLES.

TABLES I. AND II.

Difference of Latitude and Departure for Points and Degrees.

THESE Tables are of very extensive use in Navigation, affording an easy and expeditious method of solving all problems in right-angled plane trigonometry, and consequently applicable to the various sailings, but particularly useful in working a traverse, whence they obtain the name of *Traverse Tables.*

Table I. contains the difference of latitude and departure (in whole numbers and tenths), answering to distances not exceeding 300, and for courses to every quarter point of the compass. Table II. is of the same nature and extent, but for courses consisting of whole degrees. The courses are set down at the top of the pages when they do not exceed 4 points or 45 degrees, and at the bottom when they are greater than these quantities: the distances are regularly arranged in the columns marked *Dist.*, the first beginning at 1, and ending at 60; the second beginning at 61, and ending at 120, and so on to 300: corresponding to each of these distances, the difference of latitude and departure are set down in adjoining columns, marked *Lat.* and *Dep.:* but it must be carefully observed, that when the course is less than 4 points or 45 degrees, these must be taken out as marked at the top, and when more, as noted at the bottom of the pages.

Now, as the difference of latitude and departure answering to any given course and distance are found opposite the distance in that page of the table which contains the course, if therefore any two of the four things, viz. the course, distance, difference of latitude, and departure, be given, and those two be found together in the tables, the other two things will be found in their respective places on the same page. In like manner, the parts of any right-angled plane triangle may be found (provided two of them, exclusive of the right angle, be given), by taking out the hypothenuse as a *Distance,* the perpendicular in a *Lat.* column, the base in the *Dep.* column, and the angle opposite to it as a course. Hence, when these tables are applied in parallel or middle latitude sailing, the Co. lat. or Co. mid. lat. is taken as a course, the departure or meridional distance is found in the *Dep.*

column, and the difference of longitude in the *Dist.* column; in Mercator's sailing, the meridional difference of latitude is taken out in the *Lat.* column, and difference of longitude in the *Dep.* column.

When any of the given parts (excepting the course, which is never to be multiplied or divided) exceed the limits of the table, any aliquot part, as a half, third, fourth, &c. is to be taken; and those found corresponding are to be doubled, trebled, &c. that is, multiplied by the same figure that the given number is divided by.

TABLE III.

Meridional Parts.

This table is used in resolving problems by Mercator's sailing, and in constructing charts on Mercator's projection. The meridional parts are to be taken out for the degrees answering to the given latitude at the top or bottom, and for the minutes at either side column. Thus, the meridional parts corresponding to the latitude 49° 57′ are 3470.

TABLE IV.

Mean Refraction.

This table contains the refraction of the heavenly bodies, in minutes and seconds, at a mean state of the atmosphere, and corresponding to their apparent altitudes. This correction is always to be subtracted from the apparent altitude of the object. *Ex.* The mean refraction to the apparent altitude 10° 50′ is 4′ 51″.

TABLE V.

Depression, or Dip of the Horizon.

This correction arises from the elevation of the observer above the surface of the sea, whereby the visible horizon, or that seen by the observer, is below the true; and, consequently, altitudes taken with the quadrant are too great by a quantity to be taken out from this table, with the height of the observer's eye in feet, and to be subtracted from the observed altitude. *Ex.* The dip for 20 feet is 4′ 17″.

TABLE VI.

The Sun's Parallax in Altitude.

The sun's parallax in altitude is exhibited in this table to every tenth degree, and is always additive to the apparent altitude.

TABLE VII.

The Moon's Augmentation.

The moon's horizontal semidiameter, as given in the Nautical Almanac, is to be increased by a number of seconds, called the augmentation, taken out from this table nearest answering to his altitude, in order to give the true semidiameter.

TABLE VIII.

Dip of the Sea at different Distances from the Observer.

When that part of the horizon immediately under the sun is obstructed by land, and the observer is nearer the shore than five or six miles, then, if the object be brought down to the line separating the sea and land, the dip will exceed that shewn in Table V., which is calculated for an open and unobstructed horizon, and will increase as the distance from the land diminishes. In this case, the dip is to be taken from the present table with the height of the eye at the top, and the distance estimated in miles in the side column.

TABLE IX.

To correct the observed Altitude of the Sun's lower limb.

This Table is intended to simplify the usual method of correcting the observed altitude of the sun's lower limb, when taken by a fore observation, by shewing the correction at once for the joint effect of the sun's semidiameter, dip of the horizon, refraction, and parallax; and as it does not extend to altitudes less than 5°, the least altitude at which observations can be depended on for their accuracy, the corrections are always additive *to* the observed altitude of the sun's lower limb. These corrections being computed to minutes and tenths, the tenths may easily be reduced to seconds by multiplying them by six. In this Table the sun's semidiameter is assumed at 16 minutes, and its variation from that quantity in each month of the year, given at the bottom of the Table, is to be added to, or subtracted from, the correction found in the Table, according as the sign + or — is prefixed to it.†

The simplicity of this Table will appear sufficiently obvious in the following Examples.

EXAMPLE I.

Suppose the observed altitude of the sun's lower limb, by a fore observation to be 49° 57′ 30″, in the month of May, and the height of the eye 20 feet; required the true altitude of the sun's center.

		°	′	″
Observed altitude of the sun's lower limb - -		49	57	30
Correction to altitude 50°, and dip 20 feet -	10′.9			
Correction for variation of sun's semidiameter in May	— 0 .2			
	10 .7=+		10	42
True altitude of sun's center - - - -		**50**	**8**	**12**

EXAMPLE II.

Let the observed altitude of the sun's lower limb, taken in the month of February, be 12° 32′ 15″, and the height of the eye 14 feet: required the true altitude of the sun's center

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† This Table was computed by Mr. W. Galbraith, Teacher of Mathematics, at Edinburgh, who kindly presented it to the author for insertion in the present work.

		° ′ ″
Observed altitude of the sun's lower limb - -		12 32 15
Correction to altitude 12° 30′ and dip 14 feet -	8.′2	
Correction for variation of sun's semidiameter -	+0. 2	
	8. 4 = +	8 24
True altitude of sun's center - - - -		12 40 39

TABLE X.

Sun's Declination.

The sun's declination is given in this Table in degrees and minutes, for the years 1828, 1829, 1830, and 1831, at noon on each day of the year under the meridian of Greenwich; but will answer for several subsequent years by applying the corrections from Table XI.* The Table is to be entered with the year and month at the top, and the day in either side column, at the same time it is to be noted whether the declination be North or South, as expressed in each column.

TABLE XI.

To correct the Sun's Declination.

As the sun's declination in Table X. is adapted to the meridian of Greenwich, when the ship is considerably to the eastward or westward of that meridian, it should be corrected by a number of minutes taken from this Table (placed at the bottom of the first and second pages of Table X.) with the declination at the top, and the nearest longitude in the side columns, to be added or subtracted, as directed at the head of the table.

EXAMPLE.

Required the Sun's declination at noon on Sept. 18th, 1830, in longitude 108° West.

Sun's declination, from Table X. -	1°59′ North.
Correction for longitude, Table XI. to be sub.	— 7
Sun's true declination	1 52 North.

TABLE XI.*

This Table is intended to correct the sun's declination given in Table X. for the change that takes place in periods of 4 years. The Table is to be entered with the period of years in either of the side columns, and the month and nearest day at the top; the minutes of correction there found are to be added to, or subtracted from, the declination taken from Table X., answering to the number of years, reckoning in periods of 4 years, prior to that of the given year, as denoted at the head of the column; that is, the correction is to be added when the declination is increasing, or subtracted when decreasing.

EXAMPLE.

Required the Sun's declination at noon, on February 19th, 1841, at the meridian of Greenwich.

The year 1841 being a period of 12 years after 1829, find the declination in Table X. for the given day in the year 1829, which is 11° 15′ S.; then enter Table XI.* under the month of February; opposite the period of 12 years, and under the 19th of the month, will be found the correction 2′, which is to be subtracted from the above declination 11° 15′ S. and the remainder 11° 13′ S. will be the required declination.

TABLE XII.

Amplitudes.

This table is intended to expedite the method of finding the variation of the compass by comparing the magnetic with the true amplitude: the latter is here given in degrees and minutes, and is to be found with the declination at the top and the latitude in the left side column: moreover, when the minutes of the latitude or declination are nearly 30, or half a degree, the mean of the amplitudes found for the two nearest degrees will give the amplitude required, as shewn in the following examples.

EXAMPLE I.

What is the Sun's true amplitude, in latitude 51° 31′ N., when the declination is 8°?

True amplitude by table for lat. 51° and declination 8°	-	12°	47′
- - - - lat. 52 and declination 8	-	13	4
	2)	25	51
Sun's true amplitude required	-	12	55

EXAMPLE II.

Required the Sun's true amplitude, in latitude 34° 5′, when the declination is 18° 32′.

True amplitude by table for lat. 34° and declination 18°	-	21°	53′
- - - - lat. 34 and declination 19	-	23	7
	2)	45	0
Sun's true amplitude required	-	22	30

EXAMPLE III.

On what points of the horizon does the Sun rise and set, in latitude 57° 36′ N., when his declination is 18° 28′ S.?

Sun's true amplitude for lat. 57° and declination 18°	-	34°	34′
- - - lat. 57 and declination 19	-	36	43
- - - lat. 58 and declination 18	-	35	40
- - - lat. 58 and declination 19	-	37	54
	4)	144	51
Sun's true amplitude required	-	36	13

Hence the sun rises E. 36° 13′ S., or S. E. ¾ E.
and sets W. 36 13 S., or S. W. ¾ W.

In the same manner, the true amplitude of the moon, planets, or stars, may be found, when their declination and the latitude are given.

TABLE XIII.

Semidiurnal and Seminocturnal Arches,
For finding the Time of the Rising and Setting of the Sun, Moon, or Stars.

This table exhibits half the time that a celestial object continues above the horizon when the declination and latitude are of the same name, or below when they are of contrary names; usually called its semidiurnal and seminocturnal arches, from whence the time of its rising and setting may be computed: these are to be taken out with the latitude in either side column and the declination at the top; then the angle of meeting will point out the arch required, which, if the object be the sun, will be the time of its setting when the latitude and declination are of the same name, or of its rising when they are of contrary names; and this, subtracted from 12 hours, will give the time of the sun's rising in the former case, and of its setting in the latter: double the time of his rising will be the length of the night, and double the time of his setting the length of the day.

EXAMPLE.

Required the time of the Sun's rising and setting, with the length of the day and night, in latitude 51° 31′ N., when the declination is 20° N.

	h.	m.
The time answering to lat. 51° and declin. 20° is -	7	47
- - - lat. 52 and declin. 20 - -	7	51
	2)15	38
Time of sun's setting, because lat. and declin. are both N.	7	49
	12	
Time of sun's rising - - - - -	4	11
Double the rising gives the length of the night - -	8	22
Double the setting gives the length of the day - -	15	38

To find the time of a star's rising and setting, subtract the sun's right ascension from the star's right ascension (increasing the star's right ascension by 24 hours, if it be less than the sun's), and the remainder will be the time of the star's passing the meridian*; then the latitude and declination, when they are of the same name, will give the time the star takes in ascending from the horizon to the meridian, and descending from the meridian to the horizon; therefore, if these hours and minutes be subtracted from the time of its passage over the meridian, the remainder will be the time of its rising, and, if added, the sum will be the time of its setting.

But when the latitude and declination are of contrary names, the time found as above will be half the star's continuance under the horizon; consequently, it is to be subtracted from 12 hours to give half the time of its continuance above the horizon; with which proceed as before.

* The time of 61 of the principal star's passing the meridian will be found in Table XV.

EXAMPLE I.

At what time does the Star Arcturus rise and set on June 1st, in latitude 51° North.

	h.	m.	
Star's right ascension by Table XIV.	14	7	
Sun's right ascension, June 1st, by Table XIV.*	4	35	
Time of the star's passing the meridian	9	32	
Time answering to lat. 51° N. and star's declin. 20° N. is	7	47	
Remainder gives the time of the star's rising	1	45	
Sum gives the time of the star's setting	17	19	P. M.
or	5	19	A. M.

EXAMPLE II.

At what time does the Star Regulus rise and set on May 10th, in latitude 33° South.

	h.	m.	
Star's right ascension by Table XIV.	9	59	
Sun's right ascension, May 10th, by Table XIV.*	3	8	
Time of star's passing the meridian	6	51	
Time answering to lat. 33° S. and star's declin. 13° N., subtracted from 12 hours, is	5	26	
Remainder gives the time of the star's rising	1	25	
Sum gives the time of the star's setting	12	17	P. M.
or	0	17	A. M.

After the same manner, the time of the rising and setting of the planets may be computed, observing to take out their declination and passage over the meridian from Page IV. of the Nautical Almanac.

To find the rising and setting of the moon, the time of her passage over the meridian is to be taken from Page VI. of the Nautical Almanac, to which the minutes from Table XVI. are to be applied, in order to obtain the time of its passing the meridian of the given place; then the semidiurnal arch answering to the moon's declination (given in Page VI. of the N. A.) and the latitude of the place, subtracted from the above reduced time, will give the approximate time of the moon's rising, or, added thereto, will give that of setting. But as the moon changes her declination sometimes very rapidly, if greater accuracy is required, it must be reduced to the approximate time of its rising or setting by Table XVIII.; then the semidiurnal arch being again found and corrected by adding the minutes from Table XVI. corresponding thereto, and the daily variation of her passage over the meridian, the sum, subtracted from or added to the reduced passage over the meridian, will give the time of her rising or setting.

EXAMPLE.

Required the time of the Moon's rising at St. Helena, in lat. 15° 55′ S. and long. 5° 43′ W., on July 4, 1830.

	h.	m.
In Page VI. of the N. A. the time of the moon's passing the meridian of Greenwich is 11h. 1m. to which 1 minute (the number from Table XVI. answering to the daily variation 52m. and longitude 5° 43′) being added, gives the time of her passing the meridian of St. Helena	11	2
Time answering to lat. 16° S. and moon's declin. 18½° S.	6	22
Remainder gives the approximate time of moon's rising	4	40

The moon's declination at this time reduced to the meridian of Greenwich by Table XVIII. is 18° 27′ South.

	h.	m.
Time answering to lat. 16° S. and declin. 18° 27′ S.	6	22
Corr. from Table XVI. to 6h. 22m. and daily var. 52m.	+	14
Semidiurnal arch	6	36
Reduced time of moon's passing the meridian	11	2
Time of moon's rising	4	26

It must be understood, that the above methods are only approximations, and may deviate two or three minutes from the truth; but it is presumed they will be found sufficiently exact for nautical purposes.

The semidiurnal and seminocturnal arches may be found independent of this table, by adding together the log. tangents of the given latitude and declination, which sum will be the log. sine of an arch in degrees, &c. to be reduced into time, and increased by 6 hours.

TABLE XIV

The right Ascensions and Declinations of the principal fixed Stars.

This table contains the right ascensions and declinations of 61 of the principal stars, taken for the most part from the catalogue published in the Nautical Almanac for the year 1818, and computed for the beginning of the year 1820, with their annual variations in seconds and decimal parts of a second. If their places are required for any time subsequent to the year 1820, the annual variation both in right ascension and declination must be multiplied by the number of years and parts of a year elapsed since that time, and the product will be the variation from the beginning of 1820 to the given time. This variation must always be added to the right ascension for 1820, but the variation in declination is additive or subtractive according as the sign + or — is prefixed to the annual variation; then the sum or remainder will be the right ascension and declination for subsequent years. But if the place of a star be required for any time preceding 1820, the variation in right ascension must be subtracted from that in the table, and the variation in declination applied contrary to the sign set against it.

EXAMPLE.

Required the right ascension and declination of the Star Arcturus in June 1828.

From the beginning of 1820 to June 1828, there are about 8½ years.

	h.	m.	s.
R. A. of Arcturus (in time) for the beginning of 1820 -	14	7	27
Annual variation +2s.73 multiplied by 8½ gives -	+		23
R. A. of Arcturus for June 1828 - - -	14	7	50
	°	′	″
Declination of Arcturus for the beginning of 1820	20	7	28 N.
Annual variation — 18″.99 multiplied by 8½ gives -	—	2	41
Declination of Arcturus for June 1828 - -	20	4	47 N.

TABLE XV.

To find the Time of the principal Stars' passing the Meridian.

In this Table the apparent times of 61 of the principal stars' passing the meridian are given for every fifth day of each month throughout the year, beginning on the first day of each month: and since the stars perform a revolution, or return to the meridian in 23 hours 56 minutes and 4 seconds, of mean solar time, that is about 4 minutes earlier every day, when the time of their transit is required for any intermediate day, it may be found by multiplying the number of days since the preceding one given in the Table, by 4, and subtracting the product from the time of the transit on that day, the remainder will then be the time of the transit on the day required. Suppose, for example, we want to know at what time the star Aldebaran will pass the meridian on February 14th. Now, by the Table, it appears that the star will pass the meridian, on the 11th of that month, at 6h. 46m.; then to find the time of its transit on the 14th, multiply 3, the number of days since the 11th, by 4; the product, 12 minutes, subtracted from 6h. 46m. will give 6h. 34m., the time of the star's passage over the meridian on the 14th February.

The times shewn in the Table being only approximations, may deviate two or three minutes from the truth, but will nevertheless be sufficiently exact for the purposes to which they are intended to be applied.

By the assistance of this Table, the method of finding the latitude by the meridian altitude of a star will be greatly facilitated; for when we know at what time nearly a star will pass the meridian, and its approximate altitude at that time, there can be no difficulty in making the requisite observation to determine the latitude: these opportunities occur frequently in the course of a clear night, and may be put in practice by any person otherwise unacquainted with the stars in the heavens; which we shall endeavour to explain by a few examples.

In the first place, the altitude of any star when passing the meridian, may be found by adding together the co-latitude of the place of observation, and the declination of the star, when they are of the same name, or taking their difference when of contrary names; the altitude to be reckoned from the South point of the horizon, when the latitude is North, and the contrary when South; but when the sum exceeds 90°, it is to be taken from 180°, and reckoned from the opposite point of the horizon, that is, from the North in North latitude, and from the South in South latitude.

Thus, having the time of the star's transit, or passage over the meridian, by the Table, and its meridian altitude nearly by calculation, set the index of the Quadrant to that altitude, and a few minutes before the time of the stars' transit, direct the sight towards the North or South points of the horizon, as shewn above, and the reflected image of the star will be perceived in the Horizon Glass, upon or near the horizon, which being brought into contact with it, and kept so until it arrives at its greatest or meridian altitude, and then read off the Quadrant, the latitude may be found by calculation.

EXAMPLE I.

Suppose on the evening of July 6th, the ship being in latitude 36° 30′ N. by account, about 9 o'clock, the latitude be required by observing the meridian altitude of a star. Now by the Table, the star Antares will pass the meridian on that day about 9h. 16m.: also by Table XIV. the declination of that star appears to be 26° 1′ S., therefore from the complement of the latitude 53° 30′ N. subtract the star's declination, because they are of contrary names, and the remainder will give the meridian altitude 27° 29′, to which set the index of the Quadrant, and directing the sight to the South point of the horizon, observe the meridian altitude of the star Antares, and thence deduce the latitude.

There is not the least danger of mistaking the star, as no other will have the same meridian altitude at that time.

EXAMPLE II.

What star will be on the meridian about 5h. A.M. on February 3d, and what will be its meridian altitude, supposing the latitude of the ship to be 15° 40′ N. by account?

	h.	m.	
By Table XV. the star Arcturus will pass the meridian on February 1st, at - - - -	17	6	
Number of days since 2 × 4 = - - -	—	8	
Arcturus will pass the meridian on February 3rd, at -	16	58	P. M.
	12	0	
or	4	58	A. M.
	°	′	
Latitude of the ship by account - - -	15	40	N.
	90		
Complement of the Latitude - - -	74	20	N.
Declination of Arcturus by Table XIV. - -	20	7	N.
	94	27	
	180		
Meridian altitude of Arcturus from the North point of the horizon - - - - -	85	33	

When the complement of a star's declination is less than the latitude, of the same name, the star will not rise or set, but pass the meridian below the pole 11h. 58m. after it has passed the meridian above the pole; its altitude being then observed, the latitude may thence be found by rules laid down for that purpose.

Its meridian, or least altitude at that time, is found by subtracting the complement of the declination from the latitude; which altitude is to be reckoned from the North or South points of the horizon according to the latitude.

EXAMPLE III.

At what time will the star Dubhe, in Ursa Major, be on the meridian below the pole on December 15th, and what will be its meridian altitude at that time in latitude 45° 40′ N.

	h.	m.
Time of Dubhe's transit above the pole Dec. 11th, Tab. XV.	17	37
Number of days to December 14th 3 × 4 =	—	12
Time of Dubhe's transit above the pole Dec. 14th	17	25
Half interval of the star's revolution	11	58
	29	23
	24	
Time of Dubhe's transit below the pole Dec. 15th	5	23 P. M.
	°	′
Declination of Dubhe by Table XIV.	62	43 N.
	90	
Complement of the declination	27	17 N.
Latitude	45	40 N.
Meridian altitude of Dubhe below the pole from the North point of the horizon	18	23

EXAMPLE IV.

At what time will the polar star pass the meridian below the pole on March 6th, and what will be its meridian altitude in latitude 61° 30′ N.?

	h.	m.
Time of polar star's transit above the pole, March 6th	1	50
Half interval of star's revolution	11	58
	13	48
	12	
Time of star's transit below the pole, March 6th	1	48 A. M.
	°	′
Declination of polar star by Table XIV.	88	21
	90	
Complement of the Declination	1	39
Latitude	61	30 N.
Polar star's meridian altitude below the pole from the North point of the horizon	59	51

TABLE XIII*

To find the Latitude by the Polar Star.

This table is to be entered with the right ascension of the meridian at the time of observation; the correction corresponding to which being added to, or subtracted from, the true altitude of the polar star, as denoted by the sign + or —, the sum or remainder will give the latitude of the place of observation.

The table is calculated particularly for the years 1820 and 1830, but will serve with tolerable accuracy for several subsequent years; the corrections may, however, be found for any other year, as follows: first reducing the right ascension and declination of the star, taken from Table XIV., to the given year.

Find the difference between the right ascension of the meridian and the star's right ascension: if the difference is more than 6 hours, and less than 12 hours, subtract it from 12 hours; if it is more than 12 hours, and less than 18 hours, subtract 12 hours from it; if more than 18 hours, subtract it from 24 hours; and the remainder, in each case, will be the star's distance from the meridian in time, which reduce to degrees by Table XIX. Find the number of degrees at the top or bottom of Table II., as if it were a course, and the complement of the declination, in minutes, as a distance corresponding to these, in the difference of latitude column, will be the correction required in minutes: this correction added to the star's true altitude, if the difference between the star's right ascension and the right ascension of the meridian is more than 6 hours, and less than 18 hours, or otherwise subtracted, the result will be the latitude of the place of observation.

EXAMPLE.

May 21, 1840, if the true altitude of the Polar Star be 50° 13′ at 10h. 15m. past noon, what will be the latitude of the place of observation?

The R. A. of the polar star, in May, 1840, will be 1h. 1m. 53s., and the declination 88° 27′ 23″ N.; consequently the complement of the declination 1° 33′, or 93 minutes.

	h.	m.
The sun's right ascension, May 21, (Table XIV*)	3	51
The time of observation - - -	10	15
Right ascension of the meridian - -	14	6
Right ascension of the polar star - -	1	2
Difference - - - -	13	4
Subtract - - - - -	12	0
Polar star's distance from the meridian - -	1	4 =16°,

which taken as a course in Table II., and the Co. declination 93′ as a distance, give in the lat. column 89 .4 minutes, or 1° 29′, the correction, to be added to 50° 13′, the star's true altitude, because the above difference is between 6 and 18 hours: hence the latitude will be 51° 42′ N.

TABLE XIV.*

The Sun's mean right Ascension.

The sun's mean right ascension, contained in this table, is to be taken out with the month at the top, and the day in either side columns. It is sufficiently exact for ascertaining the time of an object's passing the meridian, in order to obtain the latitude by its meridian altitude; but when greater accuracy is necessary, recourse must be had to the Nautical Almanac.

TABLE XV.*

To find the Time of High Water.

This Table is to be entered with the moon's semidiameter, or the nearest to it, taken from Page VII. of the month in the nautical almanac, at the top, and the time of the moon's passage over the meridian, in one of the the columns so titled; the correction thus found, which is the effect of the sun's action, in accelerating or retarding the time of high water produced by the attraction of the moon, is to be applied to the time of the moon's passage over the meridian, according as the sign + or — is prefixed to it

TABLE XVI.

To reduce the Time of the Moon's Passage over the Meridian of Greenwich to the Time of her Passage over any other Meridian.

The daily variation of the moon's passing the meridian is the excess of time above 24 hours that elapses till her return to the same, and this is found by taking the difference between her passing the meridian of Greenwich on a given day (from Page VI. in the N. A.) and the preceding, if the longitude of the place be east, or that and the following, if the longitude be west.

Now as the moon is constantly advancing to the eastward in the heavens, she will therefore pass any meridian to the eastward of Greenwich sooner in the day, or a meridian to the westward later, than she does that of Greenwich by a certain number of minutes, which is to the daily variation as the given longitude of the place is to 360°; and on this principle the table is constructed.

The table is to be entered with the daily variation at the top and the longitude of the place in the left side column; then the minutes corresponding to these being added to the time of the moon's passing the meridian of Greenwich, if the longitude be west, or subtracted if east, the sum or remainder will be the time of her passing the meridian of the place.

EXAMPLE.

At what time will the Moon pass the meridian of Calcutta, in longitude 88° 28′ E. on July 28th, 1830?

	h. m.
Moon's passage over the meridian of Greenwich July 28th, by the Nautical Almanac - - - - -	6 26
Correction corresponding to daily var. 44m. and long. 88° 28′ E -	— 11
Time of moon's passing the meridian of Calcutta, July 28th. -	6 15

This table is likewise useful in computing the time of the moon's rising and setting, as shewn in the explanation to Table XIII.

TABLE XVII.

To correct the mean Refraction.

The refractions contained in Table IV. being adapted to a mean state of the atmosphere, that is, when the thermometer stands at 50° and the barometer at 29.6 inches, if it deviates from this weight and temperature, and accuracy is required, it will be necessary, especially in low altitudes, to correct the mean refraction by the seconds contained in this table, which are to be taken out with the apparent altitude in the side column, and the heights of the thermometer and barometer at the top and bottom, to be added or subtracted as expressed at the top of the columns.

EXAMPLE.

Let the apparent altitude be 5°, the height of the thermometer 72°, and that of the barometer 29.2: required the true refraction.

Mean refraction by Table IV. to 5° altitude -		9′ 54″
Corr. for alt. 5° and 72° height of thermometer	— 31″	— 40
- alt. 5° and 29.2 height of barometer	— 9	
True refraction required		9 14

The true refraction may be found by adding to the logarithm of the difference between the height of the thermometer and 450, the log. of the height of the barometer, the logarithm of the mean refraction in seconds, and the constant logarithm 5.92665; the sum of these four logs., rejecting 10 in the index, will be the log. of the true refraction in seconds. The preceding example is thus worked by logarithms:—

450 — 72° height of thermometer, is	378	log. 2.57749
Height of barometer - -	29.2	log. 1.46538
Mean refraction 9′ 54″ or -	594	log. 2.77379
	Constant	log. 5.92665
True refraction required 554″ or 9′ 14″		log. 2.74331

TABLE XVIII.

To reduce the Moon's Declination to any given Meridian, and to any Time under that Meridian.

This table contains the proportional part of the variation of the moon's declination in twelve hours, answering to a given time from noon or midnight, and to a given longitude: it facilitates the reduction of the moon's declination, as given in Page VI. of the Nautical Almanac, and is to be entered with the variation of the moon's declination in 12 hours at the top, and with the longitude and time from the preceding noon or midnight in the side columns: the corrections thus found being applied to the declination for the preceding noon or midnight, as pointed out at the head of the table, will give the moon's reduced declination.*

* In the nautical almanac for 1823 and subsequent years, the moon's declination is given to seconds, and when great accuracy is required, may be reduced to any given time at Greenwich by proportional logarithms, and farther corrected for the equation of second difference—see Explanation of Tables XXXIV. and XXXIX

EXAMPLE I.

Required the Moon's declination on June 8th, 1830, at 9h. 25m. Greenwich time.

Moon's declination, June 8th, at noon, by Nautical Almanac	18°	36′ S.
Cor. answering to var 0° 19′ and time 9h. 25m. -	−0	16
Moon's reduced declination -	18	20′ S

EXAMPLE II.

What will be the Moon's declination on March 5th, 1830, at 15h. 45m. in longitude 75° West?

Moon's declination, March 5th, at midnight, by Naut. Alm.		15°	25′ N
Corr. to var. 1° 10′ and long. 75° W. -	−0° 29′	−0	51
- var. 1 10 and time from midnight 3h. 45m.	−0 22		
Moon's reduced declination -		14	34 N.

TABLE XIX.

To reduce Longitude into Time, and the contrary.

This table is intended to facilitate the reduction of degrees, &c. of longitude into time, or of hours, &c. into longitude. The method of using it will best appear by inspecting the following examples.

EXAMPLE I.

Required the time answering to 42° 13′ 42″ of longitude.

	°	′	″		h.	m.	s.	t.
Time answering to -	42	0	0	is	2	48	0	0
- - - -		13	0	-			52	0
- - - -			42	-			2	48
Hence the time answering to -	42	13	42	-	2	48	54	48

EXAMPLE II.

Required the degrees, &c. corresponding to 7h. 6m. 48s.

	h.	m.	s.		°	′
Long. corresponding to - -	7	4	0	is	106	0
- - - - -		2	48	-		42
Hence the long. corresponding to -	7	6	48	-	106	42

TABLE XX.

For finding the Distance of terrestrial Objects at Sea.

When the eye is elevated above the surface of the adjacent land or water, we not only see surrounding objects more distinctly, but also see those which are more remote the higher we advance. Now, although the irregularity of the surface of the land will not admit of any one rule that will give the distance to which objects may be seen at different elevations, yet at sea, where the curvature of the water is uniform, those distances may be easily computed by means of this table, in which the distances are exhibited in nautical miles and decimal parts, answering to the height of the eye or that of the given remote object, allowance having been made for terrestrial refraction.

EXAMPLE.

Being at the mast-head looking out for land, and elevated 130 feet above the surface of the sea, I discovered the top of a light-house in the horizon, whose height is known to be 300 feet: required my distance from the light-house.

	Miles
In the table opposite 130 feet is - -	13.1
- - - 300 feet is - - -	19.9
Sum gives the distance of the ship from the light-house	33.0

TABLE XXI.

To reduce the Sun's Declination to any given Meridian, and to any Time under that Meridian.

This table contains the corrections to be applied to the sun's declination as given in the Nautical Almanac, which is computed for noon at Greenwich, when it is required for noon at any other meridian, or to any given time of the day: it is to be entered with the declination for the nearest noon at the top, as found in Page II. of the Nautical Almanac, and the longitude or time from noon in the side columns; corresponding to these will be found the minutes and seconds to be applied to the above declination by addition or subtraction, as directed at the head of the table; that is, when the declination is increasing, the corrections are to be added in west longitude or after noon, and to be subtracted in east longitude or before noon; but when the declination is decreasing, the corrections are to be subtracted in west longitude or after noon, and to be added in east longitude or before noon.

When the declination and longitude, or time from noon, are not nearly found in the table, proportional parts must be used, if great exactness is required.

It must be observed, that this table is subject to an error of a few seconds from the sun's unequal motion in the ecliptic, but it is nevertheless sufficiently exact for observations taken at sea.*

EXAMPLE I.

Required the Sun's declination at noon on Sept. 19th, 1830, in longitude 105° 15′ West.

Sun's declination at Greenwich by Nautical Almanac -	1°	35′	18″	N.
Correction for longitude - - -	—	6	51	
Sun's reduced declination -	1	28	27	N

---

* When the sun's declination is required to the nearest second, the proportional part of the daily variation may be readily found by the proportional logarithms—see Explanation and Use of Table XXXIV

EXAMPLE II.

Required the Sun's declination on June 2nd, 1830, at 4h. 20m. Greenwich time.

Sun's Declination at noon by Nautical Almanac -		22°	9′	49″ N.
Correction for time - - - -		+	1	34
Sun's reduced declination -		22	11	23 N.

EXAMPLE III.

Required the Sun's declination, April 25th, 1830, at 19h. 36m. in longitude 71° 50′ West.

Sun's Declination, April 25th, by Nautical Almanac -		13°	6′	52″ N.
Correction for longitude 71° 50′ west -	+ 3′ 59″	+		20
- - time before noon 4h. 24m. -	— 3 39			
Sun's reduced declination -		13	7	12 N.

It will sometimes happen, when the sun is near the equinoxes, that the correction for longitude and time will exceed the declination: in this case, if the correction is subtractive, the declination is to be taken from it, and the remainder will be the reduced declination of a contrary name to that taken from the almanac.

EXAMPLE IV.

What will be the Sun's declination on September 23rd, 1830, at 5h. 48m. and in longitude 120° West?

Sun's declination, September 23rd, by Nautical Almanac		0°	1′	49″ N
Correction for longitude 120° W. -	—7′ 51″	—	13	32
- - time past noon 5h. 48m. -	—5 41			
Sun s reduced declination -		0	11	43 S

TABLE XXII.

To reduce the Sun's right Ascension to any given Meridian, and to any Time under that Meridian.

By this table the sun's right ascension, taken out for the nearest noon from Page II. of the Nautical Almanac, may be reduced to any given time or place. It is to be entered with the right ascension at the top, and the given longitude or time from noon in the side columns: the corrections corresponding to these being added to the right ascension, as above, if the longitude be west or the time after noon, but subtracted if the longitude be east or the time before noon; the result will be the sun's reduced right ascension.

EXAMPLE I.

Required the Sun's right ascension at noon, May 9th, 1830, in longitude 85° West.

	h.	m.	s.
Sun's right ascension by Nautical Almanac -	3	3	23
Correction for longitude 85° W. - -	+		54
Sun's reduced right ascension - -	3	4	17

EXAMPLE I

What will be the Sun's right ascension on October 10, 1830, at 10h. 50m. Greenwich time?

	h.	m.	s.
Sun's right ascension at noon by Nautical Almanac -	13	1	25
Correction for time after noon 10h. 50m. -	+	1	39
Sun's reduced right ascension - -	13	3	4

EXAMPLE III.

Required the Sun's right ascension on July 13th, 1830, at 14h. 10m. in longitude 120° West.

		h.	m.	s.
Sun's right ascension, July 13th, by Nautical Almanac		7	28	43
Correction for longitude 120° W. -	+ 1 21	—		19
- - time before noon 9h. 50m.	— 1 40			
Sun's reduced right ascension - -		7	28	24

TABLE XXIII.

Logarithmic Sines, Tangents, and Secants, to every Point and Quarter Point of the Compass.

This table is useful when the logarithmic sine, tangent, or secant of a ship's course is required to points of the compass: it is to be entered with the points in the left side, when they do not exceed 4, and the names at the top; but when they are above that quantity, the points are to be taken from the right side column, and the names from the bottom.

EXAMPLES.

The log. sine of 3 points is -	9.744739
The log. tangent of 6 points is -	10.382776

TABLE XXIV.

Logarithms of Numbers.

This table contains the decimal parts of the logarithms of numbers to six places of figures; but as, in most of the calculations which occur in navigation, five places are sufficient, it must be observed, that when the sixth figure is omitted, if it be five or above, the preceding or fifth is to be increased by 1; thus the logarithm .966986, when taken out to five places only, will be .96699.

A logarithm consists of two parts, which are separated by a point; that on the left hand of the point is called the *index;* the figures on the right hand is the *decimal part;* and as it is the latter only that is inserted in the table, the index must be supplied according to the following rules:—

The index of a logarithm is always one less than the number of figures in the whole number: hence the index of 125 is 2, being one less than the number of figures contained in 125; also 2 is the index of 162.5; for although here are four figures, yet only three of them belong to the whole number, the .5 being a decimal figure. *If the natural number consists of decimal figures only, the index is 9 lessened by the number of cyphers before the first decimal figure:* thus the index of .0051 is 7, being 9 lessened by 2, the number of cyphers before the first decimal figure; the index of .00025 is 6, because there are three cyphers before the first decimal figure.

To find the Logarithm of a natural Number.

If the number consists of one or two figures only. Enter the first page of the table, and in one of the columns marked No. look for the given number, opposite to this, in the column marked Log., will be found the logarithm required, to which prefix the index according to the above directions: thus the logarithm of 56 is found to be 1.748188, the logarithm of 94 is 1.973128, and of .0025 is 7.397940.

If the number consists of three figures. Find the given number in the left-hand column of the table, and opposite, in the column marked 0 at the top or bottom, will be the logarithm required, to which prefix the index as before: thus the log. of 295 is 2.469822, of 1.76 is 0.245513, and of .0542 is 8.733999.

When the number consists of four figures. Look for the first three figures in the left side column (without attending to the decimal point, if there be any), and opposite to these, in the column marked with the fourth figure at the top or bottom, is the logarithm required: thus the logarithm of 1246 is 3.095518, of 17.95 is 1.254064, and of .2678 is 9.427811.

If the number consists of five or more figures. Find the logarithm of the first four figures, as before directed; then multiply the number found opposite in the right-hand column under *diff.* (which is the difference between two adjacent logarithms) by the remaining figures; point off from the product as many figures from the right as the multiplier consists of, and those remaining being added to the logarithm of the first four figures, the sum will be the logarithm required, to which prefix the index. If the figures pointed off to the right hand exceed a half, the unit figure of the remainder is to be increased by one.—Example. Required the logarithm of 25047. First look in the left side column for 250; opposite to this, in the column with 4 at the top, is the logarithm 398634, and in the right side column the diff. 173; this multiplied by 7, the fifth figure, gives 1211; from which cut off the last figure, and the remainder 121 added to 398634 will give, with the index prefixed, 4.398755, the logarithm required. In this manner the logarithm of 598765 will be found 5.777256.

To find the natural Number corresponding to a given Logarithm.

If the number be required only to four figures. Look in the table for the logarithm nearest to that given, opposite to which will be found the first three figures in the left side column, and the fourth figure at the top or bottom; the decimal point is then to be placed so that the whole number may contain *one figure more than that expressed by the index.* Suppose, for example, the natural number corresponding to the logarithm 2.326929 be required: the nearest logarithm to this is 326950, opposite to which is 212 in the left column, and 3 at the top, which placed after the first three figures, and the decimal point fixed according to the index, will give 212.3, the natural number required.

If the number be required to five or more figures. Find the logarithm next less to the given one, which will give the first four figures; then take the difference between that and the given logarithm, to which annex as many cyphers as there are figures wanted above four; divide this by the difference found opposite the nearest less logarithm, and the quotient will be the remaining figures required.

For example—To find the natural number corresponding to the logarithm 4.478309 to five figures: the nearest less logarithm is 478278, answering to the number 3008, and the difference between that and the given logarithm is 31; to this annex a cypher, and divide by the difference 145, the quotient will be 2; therefore the number required is 30082. In the same way the natural number corresponding to the logarithm 5.497646 to six figures is 314518.

When the given logarithm consists of only five places of figures, add a cypher to the fifth figure, and proceed as before.

If the number required is to consist altogether of decimal figures, the same method must be used to obtain it as shewn above; only observe, that 9 cyphers lessened by the index are to be prefixed to the number found. Thus the number answering to the logarithm 7.819083 is .006593.

To find the arithmetical Complement of a Logarithm.

The arithmetical complement of a logarithm is the number it wants of 10.000000 or 20.000000; and the easiest way to find it is, beginning at the left hand, to subtract every figure from 9 except the last significant figure, which is to be taken from 10; but if the index exceed 9, it is to be taken from 19. Thus the arithmetical complement of 4.478309 is 5.521691, and of 10.935547 is 9.064453: it is frequently used in the rule of proportion, and trigonometrical calculations, to change subtractions into additions.

Here follow a few examples to further illustrate the preceding rules.

	Nat. Num.		Logarithms.		Logarithms.		Nat. Num.
Given	56	to find	1.74819	Given	1.36977	to find	23.43
	1.79		0.25285		2.45637		286.0
	98.76		1.99458		3.56744		3693.5
	596.84		2.775858		9.876542		.75256
	.36875		9.566732		5.123562		132911
	156795		5.195333		4.397625		24981.9

TABLE XXV.

Logarithmic Sines, Tangents, and Secants.

This table contains the logarithmic, or, as they are sometimes called, the artificial sines, tangents, and secants, to each degree and minute of the quadrant, with their complements or co-sines, co-tangents, and co-secants, to six places of figures besides the index; but it may be observed, as of the last table, that five places being generally sufficient in the common practice of navigation, when the sixth is omitted, and it is 5 or above, the preceding or fifth is to be increased by a unit.

To find the Logarithmic Sine, Co-sine, &c. of any Number of Degrees and Minutes.

If the given degrees be under 45, they are to be taken from the top, and the minutes from the left side column; opposite to which, in that column with the name of the logarithm at top, will be found the required logarithm. But if the degrees be more than 45, they will be found at the bottom of the page, and the minutes in the right side column; likewise the name of the logarithm is to be taken from the bottom of the page.

When the given degrees exceed 90, they are to be subtracted from 180 degrees, and the logarithm of the remainder taken out as before. Or the logarithmic sine, tangent, &c. of degrees more than 90, is the logarithmic co-sine, co-tangent, &c. of their excess above 90 degrees.

EXAMPLES.

	°	'		Log. to 6 places.		Log. to 5 places
Required the log. sine of	36	32	—	9.774729	—	9.77473
- co-sine of	61	18	—	9.681443	—	9.68144
- - tangent of	54	17	—	10.143263	—	10.14326
- - co-tang. of	42	50	—	10.032877	—	10.03288
- secant of	19	27	—	10.025519	—	10.02552
- - co-secant of	70	33	—	10.025519	—	10.02552
- sine of	108	36	—	9.976702	—	9.97670
- or sine of	71	24				
- or co-sine of	18	36				

To find the Degrees and Minutes nearest corresponding to a given Logarithmic Sine, Co-sine, &c.

Look in the column marked at the top or bottom with the name of the given logarithm, and, when the nearest to it is found, the corresponding degrees and minutes will be those required; observing that, when the name is at the top of the column, the degrees are to be taken from the top, and the minutes from the left side column; but if the name is at the bottom, the corresponding degrees will be there likewise, and the minutes in the right side column.

EXAMPLES.

The degrees and minutes corresponding to the

log. sine	9.265390	are	10°	37'
co-sine	9.528461		70	16
tangent	9.70156		26	42
secant	10.25413		56	9

The logarithmic sines, &c. taken out to degrees and minutes only, are in general sufficiently accurate; but in some of the more rigid astronomical calculations, such as clearing the distance in lunar observations, it is frequently necessary to take them out to the nearest second: when this is the case, they are to be found in the following manner.

To find the Logarithmic Sine, Tangent, Secant, &c. answering to a given Number of Degrees, Minutes, and Seconds.

Find the log. sine, &c. answering to the given degrees and minutes, as above, and take out from the proper column the difference of the adjacent logarithms to 100 seconds (marked at the top Diff. or D.); multiply this difference by the given seconds, and point off the two right-hand figures in the product; then those remaining being added to the log. sine, tangent, or secant of the given degrees and minutes, or subtracted from the log. co-sine, co-tangent, or co-secant, will give the logarithm required.

The differences to the sines and co-sines are set down on the right of their respective columns: the differences to the tangents and co-tangents, being the same, are placed between them; and the differences to the secants and co-secants, being the same as those to the co-sines and sines, are to be taken from the columns corresponding to the latter.

EXAMPLE I.

Required the Log. Sine of 32° 21′ 45″.

The logarithmic sine of 32° 21′ is - - -	9.728427
The diff. corresponding to the log. sine of the given degrees and minutes is 332; this multiplied by 45 (the number of seconds), pointing off two figures, is - - -	+ 149
Sum is the log. sine required - -	9.728576

EXAMPLE II.

Required the Log. Co-sine of 71° 40′ 25″.

The logarithmic co-sine of 71° 40′ is - - -	9.497682
The diff. corresponding to the log. co-sine of the given degrees and minutes is 636; this, multiplied by 25, gives -	— 159
Remainder is the log. co-sine required - - -	9.497523

EXAMPLE III.

Required the Log. Tangent of 56° 42′ 20″.

The logarithmic tangent of 56° 42′ is - - -	10.182516
The corresponding diff. 459, multiplied by 20, gives -	+ 92
Sum gives the log. tangent required - - -	10.182608

EXAMPLE IV.

Required the Log. Co-secant of 65° 18′ 23″.

The logarithmic co-secant of 65° 18′ is - - -	10.041671
The diff. corresponding to the sine of the given degrees and minutes is 97, which, multiplied by 23, gives -	— 22
Remainder is the log. co-secant required -	10.041649

The logarithmic sines and tangents varying by great differences at the beginning of the quadrant, it has been thought proper, for the sake of accuracy, to give them for the first and second degrees to every 10 seconds, with their mean differences in the right side column: when, therefore, the log. sine or tangent of an arch less than 2 degrees is required, it is to be taken out to the next less tenth second, and the opposite difference multiplied by the odd seconds; then the product, cutting off one figure to the right, is to be added as before. As the sine and tangent of an arch is the co-sine and co-tangent of the complement of that arch, the latter may be found when above 88 degrees in a similar way, taking the degrees from the bottom and the minutes from the right side, and observing to subtract the proportional part.

EXAMPLE V.

Required the Log. Sine of 1° 14′ 43″.

The logarithmic sine of 1° 14′ 40″ is - - -	8.336819
The corresponding diff. 971, multiplied by 3, gives -	+ 291
Sum is the log. sine required - - - -	8.337110

EXAMPLE VI.

Required the Log. Co-sine of 89° 21′ 25″.

The logarithmic co-sine of 89° 21′ 20″ is - -	8.051054
The corresponding diff. 1880, multiplied by 5, gives -	— 940
Remainder is the log. co-sine required - - -	8.050114

To find the Degrees, Minutes, and Seconds, answering to a given Logarithmic Sine, Co-sine, &c.

Find the logarithm next less to the given one, if it be a sine, tangent, or secant, or next greater, if a co-sine, co-tangent, or co-secant, and note the corresponding degrees and minutes; then take the difference between the logarithm thus found and the given one, to which add two cyphers, and divide that number by the difference to 100″, the quotient will be the seconds to be annexed to the degrees and minutes before found.

EXAMPLE I.

Required the Degrees, Minutes, and Seconds, corresponding to the Log. Sine 9.695476.

The log. sine next less to that given is 9.695450, answering to 29° 44′; the difference between this logarithm and the given one is 26, which, with two cyphers added, makes 2600, and this divided by 368, the diff. to 100″, gives the quotient 7″ to be annexed to 29° 44′; hence 29° 44′ 7″ are the required degrees, minutes, and seconds.

EXAMPLE II.

Required the Degrees, Minutes, and Seconds, answering to the Log. Co-sine 9.566797.

The log. co-sine next greater to that given is 9.566951, to which answers 68° 21′; the difference between this logarithm and the given one is 154, which, with two cyphers added, makes 15400; this divided by 531, the diff. to 100″, gives the quotient 29″ to be annexed to 68° 21′; hence 68° 21′ 29″ are the required degrees, minutes, and seconds.

But if the logarithm next less or greater than the given one should be found in the first four pages of the table, it will point out the degrees, minutes, and nearest less tenth second; then, to find the odd seconds, annex but one cypher to the difference found as before, and divide by the difference in the right side column.

EXAMPLE.

Required the Degrees, Minutes, and Seconds, answering to the Log. Sine 8.421604.

Here the next less logarithm is 8.421123, answering to 1° 30′ 40″: now the difference between this log. and the given one, with one cypher annexed, is 4810, which, divided by the diff. 799, gives 6″; hence 1° 30′ 46″ are the degrees, &c. required.

TABLE XXVI.

Natural Sines.

In this table the natural sines are exhibited to every degree and minute of the quadrant, and arranged so that the degrees corresponding to the sines are to be taken from the top of the page with their minutes in the left side columns, and the degrees answering to the co-sines from the bottom with their minutes in the right side columns; moreover, as they are given to six places of figures, the same rule with respect to the fifth figure must be observed when five only are required, as mentioned in the explanation of the two preceding tables.

The natural sine or co-sine of any number of degrees, &c. more than 90, is the same as the natural sine or co-sine of its supplement, found by subtracting them from 180°; or the natural sine or co-sine of an arch greater than 90° is the natural co-sine or sine of its excess above 90°.

To find the Natural Sine or Co-sine of a given Number of Degrees, Minutes, and Seconds;

Or, to find the Degrees, Minutes, and Seconds, corresponding to a given Natural Sine or Co-sine.

These are to be found as directed for the logarithmic sines, &c. excep that the differences to 100″ are to be taken from the bottom of that column containing the given degrees in the former case, or the nearest natural sine or co-sine in the latter.

EXAMPLE I.

Required the Natural Sine of 32° 21′ 45″, or its Supplement 147° 38′ 15″.

The natural sine of 32° 21′ is - - -	535090
The difference at the bottom of the column containing the natural sine of the given degrees and minutes is 409; this multiplied by 45, pointing off two figures in the product, is - -	+ 184
Sum is the natural sine required - - -	535274

EXAMPLE II.

Required the Natural Co-sine of 71° 40′ 25″, or 108° 19′ 35″.

The natural co-sine of 71° 40′ is	-	-	314545
The difference 460, multiplied by 25, pointing off two figures, is			— 115
Remainder is the natural co-sine required	-	-	314430

EXAMPLE III.

Required the Degrees, Minutes, and Seconds, answering to the Natural Sine 495994.

The natural sine next less to that given is 495964, answering to 29° 44′; the difference between this natural sine and the given one is 30, to which two cyphers being added, and that divided by 422, the difference at the bottom of the column, gives the quotient 7″ to be annexed to 29° 44′. Hence 29° 44′ 7″, or its supplement 150° 15′ 53″, are the degrees, &c. required.

EXAMPLE IV.

Required the Degrees, Minutes, and Seconds, answering to the Natural Co-sine 368805.

The natural co-sine next greater to that given is 368936, to which answers 68° 21′; the difference between this natural sine and the given one is 131, to which two cyphers being added, and that divided by 451, the difference found at the bottom of the column, gives the quotient 29″. Hence 68° 21′ 29″, or its supplement 111° 38′ 31″, are the degrees, &c. required.

To find the Natural Versed Sine of a given Number of Degrees, Minutes, and Seconds.

If the given arch be less than 90°, find its natural co-sine, which subtract from 1000000, and the remainder will be the natural versed sine required. But if the given arch exceed 90°, find the natural co-sine of its supplement, which add to 1000000, and the sum will be the natural versed sine required.

EXAMPLE I.

Required the Natural Versed Sine of 20° 39′.

The natural co-sine of 20° 39′ is 935752, which, subtracted from 1000000, leaves 064248, the natural versed sine of 20° 39′.

EXAMPLE II.

Required the Natural Versed Sine of 146° 38′ 40″.

The natural co-sine of 33° 21′ 20″ (the supplement of 146° 38′ 40″) is 835274, which added to 1000000, the sum 1835274 is the natural versed sine required.

To find the Degrees, &c. corresponding to a given Natural Versed Sine.

Take the difference between the given natural versed sine and 1000000, and the remainder will be a natural co-sine; the degrees, &c. corresponding to which, will be those required, if the given natural versed sine be less than 1000000, but if otherwise, it will be their supplement.

EXAMPLE. I.

Required the Degrees, &c. answering to the Natural Versed Sine 098965.

The above, subtracted from 1000000, leaves 901035, which, taken as a natural co-sine, corresponds to 25° 42′ 20″.

EXAMPLE II.

Required the Degrees, &c. answering to the Natural Versed Sine 1160172.

Here 1000000, subtracted from the above, leaves 160172, which, taken out as a natural co-sine, corresponds to 80° 46′ 59″; therefore its supplement 99° 13′ 1″ are the degrees, &c. required.

TABLES XXVII, XXVIII, XXIX.

Logarithmic Solar Tables.

These Tables were first constructed by Mr. Douwes, Examiner of the Marine Cadets at Amsterdam, for the express purpose of finding the latitude by two altitudes of the sun and the elapsed time; but they are now applied to several other problems in nautical astronomy.

These Tables are to be entered with the hour at the top of the page, the minutes in the left hand column, and nearest less fifth second at the top of the respective columns. The proportional parts for the remaining seconds, are to be taken from the right hand marginal columns, from those opposite to the logarithms taken from the body of the table: hence the time answering to the given logarithm, and the contrary, may be readily found to the nearest second, as will appear obvious by the following examples.

EXAMPLE I.

Required the Logarithm answering to the half-elapsed Time 1h. 29m. 20s.

In Table XXVII. and in the page with 1 hour at the top, opposite 29 minutes, and in the column marked with 20ˢ at the top, will be found 0.42022, the logarithm required.

EXAMPLE II.

Required the Log. half elapsed time answering to 1h. 17m. 28s.

The Log. half-elapsed time (Table XXVII.) answering to 1h. 17m. 25s. is - - - - - -	0.47964
Proportional part for the remaining 3s. subtractive because the Logs. are decreasing - - - - -	— 27
The Log. half elapsed time corresponding to 1h. 17m. 28s.	0.47937

EXAMPLE III.

Required the time answering to the Log. middle time 4.92784

Log. middle time next less (Table XXVIII.) corresponding to 1h. 40m. 10s. is - - - - -	4.92765
Given Log. middle time - - - - -	4.92784
Difference - - - - - -	19

In

In the Table of proportional parts opposite the nearest less Log., the number 20, being the nearest to 19, the above difference, gives 3s.: hence the middle time required is 1h. 40m. 13s.

EXAMPLE IV.

Required the Log. Rising of 2h. 55m. 43s.
The log. rising of 2h. 55m. 40s. (Table XXIX.) is - 4.44662
The prop. part for 3 seconds, found in the right-hand column opposite the above log. is - - - - - + 23
Hence the log. rising of 2h. 55m. 43s. is - - 4.44685

EXAMPLE V.

Required the Time corresponding to the Log. Rising 4.73494.
The given log. rising is - - - - 4.73494
The log. rising next less is - - - 4.73488
Diff. - 6

In the right-hand column, opposite the above log. the nearest proportional part is 5, which gives 1 second; this added to 4h. 11m. 15s. the time answering to the next less log. gives 4h. 11m. 16s. the time required.

It is necessary to notice, that the indices in these tables sometimes change in the columns where they could not be inserted for want of room; this may however easily be known, by observing that the first figure of the decimal part of the logarithms change from 9 to 0; for instance, the log. rising of 0h. 32m. 25s. is 2.99942, but of 0h. 32m. 30s. it is 3.00164.

EXAMPLE VI.

Required the Log. Rising of 1h. 43m. 24s.
The log. rising of 1h. 43m. 20s. is - - - 3.99972
The prop. part for 4 seconds, found in the right-hand column opposite the above log. is - - - - + 56
Hence the log. rising of 1h. 43m. 24s. is - - 4.00028

In these Tables, the Logarithms for the first ten minutes of time varying by great differences, the proportional parts for the intermediate seconds could not be inserted, they must therefore, if required, be found by the rule of proportion.

TABLE XXX.

Correction of the Moon's apparent Altitude.

This table contains the correction to be added to the moon's apparent altitude in order to obtain the true, being the parallax in altitude lessened by refraction, the former of which makes the moon appear lower, and the latter higher, than her true place: this correction is likewise used in reducing the moon's apparent distance from the sun, or a star, to the true. The table is to be entered with the moon's apparent altitude to the nearest less tenth minute in the left side column, and the minutes of horizontal parallax at the top; the proportional part for the odd minutes of altitude may be found at the bottom of the page, observing that when the altitude is less than 10 degrees, to take the proportional part out with the nearest less tenth minute of altitude at the side, and the odd minutes at the top. The proportional part answering to seconds of parallax is to be taken from the right-hand part of the table, opposite the nearest less tenth second, and under the unit seconds. If the moon's parallax is less than 54 minutes, the proportional part from the right-hand side of the table, answering to the difference between the given horizontal parallax and 54 minutes, is to be subtracted from the correction corresponding to the given altitude and 54 minutes.

EXAMPLE I.

Required the Correction corresponding to the Moon's apparent Altitude 33° 44′ and horizontal Parallax 56′ 57″.

Correction to altitude 33° 40′ and horizontal parallax 56′ -		45′ 11″
Proportional part to 4′ of altitude - -	— 2″	+ 46
- - to 57″ of horizontal parallax -	+ 48	
Moon's correction required - - - -		45 57

EXAMPLE II.

Let the Moon's apparent Altitude be 48° 36′, and horizontal Parallax 53′ 40″; required the corresponding Correction.

Correction to alt. 48° 30′ and horizontal par. 54′ - -		34′ 56″
Proportional part to 6′ of altitude - -	— 4″	— 17
- - to 20″ of hor. par. - -	— 13	
Moon's correction required - - - -		34 39

The correction of the moon's apparent altitude may be found independent of this table, by adding together the log. secant of the apparent altitude (rejecting 10 in the index) and the proportional logarithm of the horizontal parallax; the sum of these will be the proportional logarithm of the parallax in altitude, from which subtract the refraction (taken from Table IV.) answering to the apparent altitude, and the remainder will be the moon's correction.

The first example above will be thus worked:—

	° ′		
Moon's apparent altitude -	33 44	- Secant -	0.0801
Moon's horizontal parallax -	56′ 57″	- Prop. Log.	0.4998
Moon's parallax in altitude -	47 22	- Prop. Log.	0.5799
Refraction - - -	1 25		
Moon's correction -	45 57		

TABLE XXXI.

Logarithmic Difference.

The logarithms in this table are applied in several methods of reducing the apparent to the true distance, particularly in those of Mr. Dunthorne. They are to be taken out with the given degree of the moon's apparent altitude at the top, and the nearest less tenth second of horizontal parallax in the left side column; the proportional part for the minutes of altitude, which is subtractive, is found by multiplying the difference to 100 minutes taken out of the right side column opposite the horizontal parallax, by the given minutes, and striking off two figures to the right; that answering to the odd seconds of parallax is found at the bottom part of the page under the given seconds, and is also subtractive. This logarithm is likewise to be further diminished by a number taken from the bottom of the page answering to the sun or star's altitude. The last correction may be more exactly taken from Tables XXXII. XXXIII.

EXAMPLE.

Required the Logarithmic Difference corresponding to the Moon's apparent Altitude 45° 9′, the Sun's apparent Altitude 10° 14′, and the Moon's horizontal Parallax 57′ 34″.

Log. diff. to moon's app. alt. 45° and hor. par. 57′ 30″ is		9.995045
The diff. 150, mult. by 9, gives the prop. part	— 13	
Prop. part to 4″ of horizontal parallax	— 6	— 26
Correction for sun's altitude 10°	— 7	
Logarithmic difference required		9.995019

TABLES XXXII. XXXIII.

To correct the Logarithmic Difference.

These tables are intended to correct the logarithmic difference for the sun or star's apparent altitude, with which they are to be entered, and the corresponding number subtracted from the logarithmic difference.

TABLE XXXIV.

Proportional Logarithms.

These logarithms were first calculated by Dr. Maskelyne, in order to facilitate the operation of finding the apparent time at Greenwich, by comparing the observed distance between the moon and the sun, or a fixed star, when reduced to the true, with those set down in the Nautical Almanac, for every third hour of Greenwich time; and are likewise frequently applied in other calculations where sexagesimals are concerned. The table is to be entered either with degrees and minutes, or hours and minutes, at the top, and seconds in either side column. Thus the proportional logarithm of 0° 15′ 36″, or 0h. 15m. 36s. is 1.0621.

The proportional logarithm of any given number of seconds is found by subtracting its logarithm from 4.033424, which is the logarithm of the seconds in 3 hours or degrees.

Proportion by logarithms being performed by adding together the arithmetical complement of the logarithm of the first term, to the logarithm of the second and third terms, rejecting 10 from the index, this Table may therefore be readily applied in finding the fourth term of a proportion in sexagesimals; as we shall shew in the following examples.

EXAMPLE I.

Suppose the Sun's altitude to decrease 51′ in 16m. 23s. of time, how much will it decrease in 8m. 6s.

As	16m. 23s.	-	Prop. Log. (Arith. Comp.)		8.9591
Is to	8m. 6s.	-	Prop. Log.	-	1.3468
So is	0° 51′	-	Prop. Log.	-	.5477
To decrease of alt.	25′ 13″	-	Prop. Log.	-	.8536

EXAMPLE II.

Let the altitude of the moon's upper limb, observed at 3h. 28m. 44s., be 20° 3′; and 20° 45′ when taken at 3h. 38m. 20s.; required its altitude at 3h. 33m. 47s.

	h. m. s.		h. m. s.		° ′
Time at first alt.	3 28 44	Time at first alt.	3 28 44	First alt.	20 3
Time at second alt.	3 38 20	Time at req. alt.	3 33 47	Second alt.	20 45
Diff.	9 36	Diff.	5 3	Diff.	0 42

As	9m. 36s.	-	Prop. Log. (Arith. Comp.)		8.7270
Is to	5m. 3s.	-	Prop. Log.	-	1.5520
So is	42′ 0″	-	Prop. Log.	-	.6320
To increase of alt. +	22′ 6″		Prop. Log.	-	.9110
First observed altitude	20 3 0				
	20 25 6		Altitude of moon's upper limb at 3h. 33m 47s.		

Although this Table is extended only to 3 hours or 3 degrees, yet by taking such terms as exceed those quantities one grade lower, that is, esteeming the hours or degrees as minutes, and the minutes as seconds, proportions may be worked as above; hence this Table may be very conveniently applied to the reduction of the sun's or moon's right ascension or declination to any given time at Greenwich.

To reduce the Sun's Declination or Right Ascension to any given time at Greenwich.

Rule. To the constant logarithm 9.1249* add the proportional logarithm of the hours and minutes (taken out as minutes and seconds) since the preceding noon, and the proportional logarithm of the daily variation, the sum will be the proportional logarithm of the variation in the given time.† Always to be added to the right ascension at the preceding noon (taken from the Nautical Almanac) but added to or subtracted from the declination, according as it is increasing or decreasing.

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* The arithmetical complement of the proportional logarithm of 24 minutes.

† Those who are acquainted with the rule of practice may readily find the proportional part of the daily variation by taking aliquot parts.

EXAMPLE I.

Required the Sun's declination on August 12, 1830, at 7h. 36m. Greenwich time, the daily variation being 18′ 6″ by the Nautical Almanac.

		Constant Log.	9.1249
Greenwich time -	7h. 36m. -	Prop. Log.	1.3745
Daily variation -	18′ 6″ -	Prop. Log.	.9976
Variation in 7h. 36m. —	5′ 44″ -	Prop. Log.	1.4970
Declin. at noon Aug. 12 by Nautical Almanac	15° 4 35 N.		
Sun's reduced declination -	14 58 51 N.		

EXAMPLE II

Required the Sun's declination March 28th, 1830, at noon, in longitude 126° East.

	h. m.
Time at Ship, March 27th -	24 0
Longitude in time (XIX.) -	8 24 E.
Time at Greenwich March 27th	15 36

	h. m.		
		Constant Log.	9.1249
Greenwich time -	15 36 -	Prop. Log.	1.0621
Daily variation -	23′ 28″ -	Prop. Log.	.8848
Variation in 15h. 36m.	+ 15′ 15″ -	Prop. Log.	1.0718
Declination at noon, March 27, by Nautical Almanac	2° 30 58 N.		
Sun's reduced declination	2 46 13 N.		

EXAMPLE III.

Required the Sun's right ascension, April 21, 1830, in longitude 127° 42′ West, at 8h. 14m. 15s.

	h. m. s.
Time at Ship	8 14 15
Long. in time (XIX.)	8 30 48 W.
Time at Greenw.	16 45 3

	h. m. s.
Sun's right ascen. April 21,	1 54 53.3
Sun's right ascen. April 22,	1 58 37.5
Variation in 24 hours	3 44.2

	h. m. -		
		Constant Log.	9.1249
Greenwich time -	16 45 -	Prop. Log.	1.0313
Daily variation -	3m. 44s. -	Prop. Log.	1.6832
Variation in 16h. 45m.	+ 2m. 36s. -	Prop. Log.	1.8394
Sun's right ascen April 21, by Nautical Almanac	1h. 54 53		
Sun's reduced right ascension	1 57 29		

To reduce the Moon's right Ascension and Declination to any given time at Greenwich.

Rule. To the constant logarithm 8.8239,* add the proportional logarithm of the hours and minutes (taken out as minutes and seconds) since the preceding noon or midnight, and the proportional logarithm of the variation in 12 hours; the sum will be the proportional logarithm of the variation in the given time, to be applied as in the preceding rule.

As the variation of the moon's right ascension in 12 hours always exceeds 3°, the limit of the Table, and the declination sometimes the same, in this case, take an aliquot part of the variation, as the half or a third, and the result will give the same part of the variation in the given time, which multiply by 2 or 3 to find the whole quantity.

EXAMPLE.

Required the **Moon's right ascension** and declination on May31, 1830 at 3h. 45m in longitude 75° West.

		h.	m.
Time at place of observation		3	45
Longitude in time	-	5	0 W.
Time at Greenwich	-	8	45

		°	′	″		°	′	″
Moon's right ascen. at noon May31,		182	25	31	Moon's dec. at noon May31,	0	30	39 N
———— at midn. ——		188	2	32	——— at midn. ——	1	22	45 S
Moon's variation in 12 hours	3)	5	37	1	Variation in 12 hours	1	53	24
One third of do.		1	52	20				

	h.	m.				
					Constant Log.	8.8239
Greenwich time	8	45		-	Prop. Log.	1.3133
⅓ Variation of R. A. in 12 hours	1°	52′	20″	-	Prop. Log.	.2048
	°	**′**	**″**			
	1	21	54	-	Prop. Log.	.3420
		×	3			
Variation of R. A. in 8h. 45m.	4	5	42			
Moon's right ascen. at noon May 31, by Naut. Alm.	182	25	31			
Moon's reduced right ascen.	186	31	13			

	h.	m.				
					Constant Log.	8.8239
Greenwich time	8	45		-	Prop. Log.	1.3133
Variation of declin. in 12 hours	1°	53′	24″	-	Prop. Log.	.2007
	°	**′**	**″**			
Variation of declin. in 8h. 45m.	1	22	40	-	Prop. Log.	.3379
Moon's declin. at noon M by Nautical Almanac	0	30	39 N.			
Moon's reduced declination	0	52	1 S.			

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* The arithmetical complement of the proportional logarithm of 12 minutes.

TABLE XXXV.

To correct the apparent Distance.

This table contains a correction applied in reducing the apparent to the true distance by the approximate methods. It is to be entered with the distance at the top or bottom, and the moon's correction in altitude and in distance (or second correction) alternately, in the side column; the difference between the numbers of seconds thus taken out is to be added to the corrected distance when less than 90°, or subtracted when above.

EXAMPLE.

Required the Correction corresponding to the Distance 70°, the Moon's Correction in Altitude 36′, and the Moon's Correction in Distance 13′.

In the column with 70° at the top, and opposite 36′ in the side column, is found 4″; again, in the same column, opposite 13′ in the side column, stands 1″; the difference of these two numbers of seconds, viz. 3″, is to be added to the corrected distance, because it is less than 90°.

This table is somewhat altered from the original when the distance is above 90° (the seconds being the complement to 20 of those formerly given), in order to adapt it to an easy and general method of clearing the distance, by Joseph de Mendoza Rios, Esq. F. R. S. When his method is used, the seconds are to be taken out with the apparent distance at the top or bottom, and the moon's correction and difference of corrections in the side column.

TABLE XXXVI.

Equations to equal Altitudes.

Observations of the sun, taken when at equal altitudes, afford an easy and accurate method of ascertaining the time shewn by a watch at apparent noon, and from thence its error: but since the sun changes his declination more or less during the interval between the corresponding altitudes, the middle of the times by the watch when they were taken will not be that shewn by it when the sun passes the meridian; and hence a correction, called the equation to equal altitudes, becomes necessary to be applied to the middle of the times, which may be easily computed by means of this table.

The table is divided into two parts, the arguments of which are the sun's longitude and the interval between the observations; the former to be taken from the top and the latter from the left side column, and when these cannot be exactly found, proportional parts must be employed.

The first part being found, its logarithm is to be added to the log. tangent of the given latitude, and the sum will be the logarithm of the reduced equation; which is additive or subtractive according to the signs at the top of the column when the given latitude is north, but the contrary to that expressed by the signs when the given latitude is south.

The second part is to be taken out in the same manner as the first, and is always additive or subtractive, as denoted by the signs at the top of the column from whence it was taken without any regard to the distinction of north or south latitude.

EXAMPLE.

Let the Sun's Longitude be VII signs 17° 45′, the Latitude 57° 9′ N., and the Interval 5h. 17m.; required the Equation to equal Altitudes.

	1st Part.		2d Part
Equation to VII signs 15°, & interv. 5 hours	$12^s.12$	- - -	$2^s.82$
Prop. part. to diff. .99 for sun's long. 2° 45′	— .54	Diff. .01 for sun's long. 2° 45′	+ .00
- to diff. .12 for time - 17m.	+ .08	Diff. .07 for time - 17m.	— 06
Equation to VII^s 17° 45′, & interv. 5h. 17m.	11.66	- - -	2.76

Lat.	57° 9′	-	Tang.	10.18907
Equat. first part -	$11^s.66$	-	Log.	1.06670
Red. equat. first part	+ 18.06	-	Log.	1.25667
- sec. part	+ 2.76			

Equation to equal alts. + 20.82 or 20^s 49‴ additive, because both parts are so.

But if we suppose the latitude to be south, then the first part being subtractive, the difference of the two parts, 15^s. 30, will be the equation to equal altitudes, and subtractive because the greater part is so.

TABLE XXXVII.

To reduce the Equation of Time to any Time at Greenwich.

This table is to be entered with the difference between the equations of time, taken from Page II. of the Nautical Almanac, for the preceding and following noons at the top, and the time from the nearest noon at Greenwich in the side column; the corresponding correction is then to be applied to the equation of time for the nearest noon, as directed at the head of the table.

EXAMPLE I.

Required the Equation of Time on December 3d, 1830, at 8h. 30m. Greenwich Time.

	m.	s.
Equation of time for noon, Dec. 3d, by Nautical Almanac -	10	2.9
Correction to difference 24.0, and time after noon 8h. 30m. -	—	8.5
Reduced equation of time - - -	9	54.4

EXAMPLE II.

Required the Equation of Time on April 8th, 1830, at 16h. 35m. at St. Helena, in Longitude 5° 43′ West.

	h.	m.
Time at St. Helena - -	16	35
Longitude in time - -	+	23 W.
	16	58
	24	
Time before noon at Greenwich, April 9th	7	2

	m.	s.
Equation of time for noon, April 9th, by Nautical Almanac -	1	42.0
Correction to difference 17.1, and time before noon 7h. 2m. -	+	5.0
Reduced equation of time - -	1	47.0

TABLE XXXVIII.

To reduce the Sun's Longitude to Noon under a given Meridian.

This table is to be entered with the sun's longitude for the noon on the given day, taken from Page II. of the Nautical Almanac, in the top column, and with the ship's longitude in the side column; the corresponding correction is to be added to the sun's longitude as above, when the longitude of the ship is west, but subtracted when east.

EXAMPLE.

Required the Sun's Longitude at Noon on Nov. 10th, 1830, in Longitude 25° West.

Sun's longitude, Nov. 10th, by Nautical Almanac	VII signs	17°	36′	30″
Correction for longitude 25° west - -	-	+	4	9
Sun's reduced longitude -	VII signs	17	40	39

TABLE XXXIX.

Equations of second Differences.

If the motion of the Moon in the heavens were uniform, its right ascension and declination might be correctly obtained at any given time by proportion, as shewn in the explanation and use of Table XXXIV., which indeed will give them sufficiently exact for most nautical purposes, but as that planet is subject to great inequalities in its motion, should its place be required to the strictest accuracy, it will be necessary to apply a further correction to the right ascension or declination, as found by even proportion. This correction (called the equation of second difference) is taken from the present table; for which purpose it is to be entered with the mean of the two second differences of the moon's place, at the top, and the given apparent time at Greenwich, after noon, or midnight, in one of the side columns; and if the whole mean second difference be not found at once in the Table, the sum of the equations, answering to the several terms that make up the whole of the mean second difference, is to be taken for the whole equation.

The right ascension or declination of the Moon corrected for the equation of the mean second difference may be obtained by the following

Rule. Take from the Nautical Almanac four right ascensions or declinations, two immediately preceding, and two immediately following, the given time at Greenwich. Add together the first and fourth, and the second and third; half the difference of the sums will be the mean of the two second differences of the four right ascensions or declinations; with which enter the Table as above directed, and apply the equation so found to the approximate value, or that obtained by even proportion, of the right ascension or declination; adding the equation, when the sum of the first and fourth right ascensions is less than the sum of the second and third, or subtracting when greater; but always adding it to the approximate value of the declination; and the result will be the corrected right ascension or declination required.*

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* The above rule for finding the mean second differences, and applying the equations, is given in the explanation of Lax's Tables, and is much more simple than that by Dr. Maskelyne, in the Nautical Almanac

When the four declinations, taken from the Nautical Almanac, are not all North or all South, another rule must be applied; but in those cases, it is quite unnecessary to have recourse to second differences, as the true declination may be obtained by even proportion.

We shall now proceed to illustrate the above rules by the following

EXAMPLE.

Required the Moon's right ascension and declination June 21st, 1830, corrected for the equations of second differences, at 4h. 30m. Greenwich time

	Right Ascensions.		**Declinations.**
	° ′ ″		° ′ ″
June 20 at midn.	94 12 53	-	18 41 53
—— 21 at noon	101 37 54	-	18 33 56
—— 21 at midn.	108 56 12	-	18 9 7
—— 22 at noon	116 6 3	-	17 28 34
Sum of 1st and 4th -	210 18 56	-	36 10 27
Sum of 2d and 3d -	210 34 6	-	36 43 3
Differences of sums -	15 10	-	32 36
Mean second differences -	7 35	-	16 18

	″		″
Equation to diff. 7′ and 4h. 30m.	49.1	Equation to diff. 16′ and 4h. 30m.	112.4
———— diff. 30″ ————	3.6	———— diff. 15″ ————	1.8
———— diff. 5″ ————	0.6	———— diff. 3″ ————	0.4
Equation to diff. 7′ 35″ and 4h. 30m.	53.3	Equation to diff. 16′ 18″ and 4h. 30m.	114.6 = 1′ 55″

	° ′ ″		° ′ ″
Moon's right ascen. June 21, at noon	101 37 54	Moon's declin. June 21, at noon	18 33 56
———————— at midn.	108 56 12	———————— at midn.	18 9 7
Variation in 12 hours	3) 7 18 18	Variation in 12 hours	24 49
One third of Variation	2 26 6		

	h. m.		Const. Log. 8.8239
Greenwich time	4 30	-	Prop. Log. 1.6021
⅓ Var. of R. A. in 12 hrs.	2° 26′ 6″	-	Prop. Log. 0.0906
	° ′ ″		
	0 54 47	-	Prop. Log. 0.5166
	× 3		
	2 44 21		
☽'s R. ascen. at noon	101 37 54		
☽'s approxim. R.A. at 4h. 30m.	104 22 15		
Equa. of mean 2d, diff.	+ 53		
☽'s corr. red. R. A.	104 23 8		

-	-	8.8239
-	-	1.6021
Var. of dec. in 12 hours 24′ 49″	-	0.8605
	° ′ ″	
Var. in 4h. 30m.	0 9 18	1.2865
☽'s dec. at noon	18 33 56	
☽' approximate dec. at 4h. 30m.	18 24 38	
Equa. of mean 2d, diff.	+ 1 55	
☽'s corr. red. declin.	18 26 33	

TABLE XL.

Time from Noon when the Sun bears true East or West.

The most advantageous time for observing the altitude of the Sun or a Star, from thence to deduce the time, is when the object bears true East or West from the observer, or is at its nearest approach to those points[*]; this Table is therefore intended to determine those times when the latitude and declination are both of the same name; for when they are of contrary names the object is nearest those points when in the horizon; and in that case, the observation should be made when it is near the horizon, but not at a less altitude than 6 or 7 degrees, on account of the uncertainty of refraction at low altitudes.

The Table is to be entered with the nearest degree of declination at the top, and degree of latitude at the side column, which will give the time from noon required, if the object be the Sun; but if it be a Star, proceed thus: find the time of the star's passage over the meridian on the given day by Table XV., and the time corresponding to the latitude and declination of the star[†] from the present Table; which subtracted from, or added to, the time of its transit over the meridian, according as the observation is to be made before or after its transit, and the result will be the time required.

EXAMPLE I.

At what time will the Sun bear West on May 20th, 1830, in latitude 31° 45′ N.

By Table X. the Sun's declination on May 20th, 1830, is 19°56′ North.

The latitude 32° in the left side column, and the declination 20° at the top, give 3h. 38m. the time required, after noon.

EXAMPLE II.

At what time will the Sun bear East on February 5th, 1830, in latitude 10° 30′ South.

By Table X. the Sun's declination, February 5th, 1830, is 15° 58′ S.

	h.	m.
Time answering to latitude 10° and declination 16° -	3	28
——— latitude 11° and declination 16° -	3	9
2)	6	37
——— latitude 10° 30′ and declination 16° -	3	18

In this Example, the latitude being less than the declination, and of the same name, the Sun will not bear East, but will be at its nearest approach to that point, at 3h. 18m. before noon, that is at 8h. 42m. A. M.

EXAMPLE III.

At what time will the Star Regulus bear due East on February 9th, in latitude 47° N.

	h.	m.
Time of star's transit, February 9th, (Table XV.) -	12	29
Time answering to star's declination 13° N. (Table XIV.) and latitude 47° N. - - - - -	— 5	10
Time of star's bearing due East - -	7	19

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[*] When the latitude is less than the declination, and of the same name, the object will not pass the prime vertical, or east and west points, but continue to the northward or southward, according to the name of the latitude and declination.

[†] This Table will answer for those stars only whose declinations do not exceed 30°.

EXAMPLE IV.

At what time will the Star α Arietis bear nearest to the west point of the horizon on September 28th, in latitude 17° 5′ North.

By Table XIV. the declination of α Arietis is 22° 36′ North.

	h. m.
Time of star's transit, September 28th, (Table XV) -	13 38
Time answering to star's declination 22° 36′ N. and latitude 17° 5′ N. - - - - -	2 49
	16 27

Hence the Star α Arietis will be at its nearest approach to the west point of the horizon at 16h. 27m. after noon, or 4h. 27m. A. M.

TABLE XLI.

This table contains the proportional parts to be applied to the moon's horizontal parallax and semidiameter, given in the Nautical Almanac for noon and midnight, in order to reduce them to the time of observation: it is to be entered with the reduced time since noon or midnight at the top, and the difference in 12 hours in either side column.

TABLE XLII.

Latitudes and Longitudes.*

This table contains the latitudes and longitudes, from the meridian of Greenwich, of the principal ports, harbours, capes, shoals, rocks, &c. in the world, divided into different heads, and arranged according to the country, sea, or coast, to which they belong. The manner of finding any required place, supposing its situation nearly known, is so obvious, that it needs no further explanation.

The variation of the compass, as it stands at the present time, is occasionally inserted for the information of such persons as may not have an opportunity of finding it by observation.

TABLE XLIII.

Times of High Water.

This table contains the times of high water at full and change, and the vertical rise of the tide at spring tides, the names of the places being alphabetically arranged.

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* The Author, impressed with the importance of this Table, has used every exertion to render it as complete and correct as possible, by consulting the works of the best Navigators and Astronomers, at the same time comparing them with the most accurate charts and surveys, and by procuring the assistance of his nautical friends, from whom it has received considerable improvements; he therefore flatters himself the present Table may be esteemed not only the most extensive, but likewise the most correct, of any hitherto published: conscious, however, that errors must exist in a Table which depends on observation (although he trusts they are few and inconsiderable), he takes this opportunity of earnestly requesting the intelligent Mariner to communicate to him any he may discover; for it is only by the accumulated knowledge of such men that we can hope to approach perfection on hydrographical subjects.

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TABLE I.

Difference of Latitude and Departure for ¼ Point.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.0	61	60.9	03.0	121	120.9	05.9	181	180.8	08.9	241	240.7	11.8
2	02.0	00.1	62	61.9	03.0	122	121.9	06.0	182	181.8	08.9	242	241.7	11.9
3	03.0	00.1	63	62.9	03.1	123	122.9	06.0	183	182.8	09.0	243	242.7	11.9
4	04.0	00.2	64	63.9	03.1	124	123.9	06.1	184	183.8	09.0	244	243.7	12.0
5	05.0	00.2	65	64.9	03.2	125	124.9	06.1	185	184.8	09.1	245	244.7	12.0
6	06.0	00.3	66	65.9	03.2	126	125.8	06.2	186	185.8	09.1	246	245.7	12.1
7	07.0	00.3	67	66.9	03.3	127	126.8	06.2	187	186.8	09.2	247	246.7	12.1
8	08.0	00.4	68	67.9	03.3	128	127.8	06.3	188	187.8	09.2	248	247.7	12.2
9	09.0	00.4	69	68.9	03.4	129	128.8	06.3	189	188.8	09.3	249	248.7	12.2
10	10.0	00.5	70	69.9	03.4	130	129.8	06.4	190	189.8	09.3	250	249.7	12.3
11	11.0	00.5	71	70.9	03.5	131	130.8	06.4	191	190.8	09.4	251	250.7	12.3
12	12.0	00.6	72	71.9	03.5	132	131.8	06.5	192	191.8	09.4	252	251.7	12.4
13	13.0	00.6	73	72.9	03.6	133	132.8	06.5	193	192.8	09.5	253	252.7	12.4
14	14.0	00.7	74	73.9	03.6	134	133.8	06.6	194	193.8	09.5	254	253.7	12.5
15	15.0	00.7	75	74.9	03.7	135	134.8	06.6	195	194.8	09.6	255	254.7	12.5
16	16.0	00.8	76	75.9	03.7	136	135.8	06.7	196	195.8	09.6	256	255.7	12.6
17	17.0	00.8	77	76.9	03.8	137	136.8	06.7	197	196.8	09.7	257	256.7	12.6
18	18.0	00.9	78	77.9	03.8	138	137.8	06.8	198	197.8	09.7	258	257.7	12.7
19	19.0	00.9	79	78.9	03.9	139	138.8	06.8	199	198.8	09.8	259	258.7	12.7
20	20.0	01.0	80	79.9	03.9	140	139.8	06.9	200	199.8	09.8	260	259.7	12.8
21	21.0	01.0	81	80.9	04.0	141	140.8	06.9	201	200.8	09.9	261	260.7	12.8
22	22.0	01.1	82	81.9	04.0	142	141.8	07.0	202	201.8	09.9	262	261.7	12.9
23	23.0	01.1	83	82.9	04.1	143	142.8	07.0	203	202.8	10.0	263	262.7	12.9
24	24.0	01.2	84	83.9	04.1	144	143.8	07.1	204	203.8	10.0	264	263.7	13.0
25	25.0	01.2	85	84.9	04.2	145	144.8	07.1	205	204.8	10.1	265	264.7	13.0
26	26.0	01.3	86	85.9	04.2	146	145.8	07.2	206	205.8	10.1	266	265.7	13.1
27	27.0	01.3	87	86.9	04.3	147	146.8	07.2	207	206.8	10.2	267	266.7	13.1
28	28.0	01.4	88	87.9	04.3	148	147.8	07.3	208	207.8	10.2	268	267.7	13.2
29	29.0	01.4	89	88.9	04.4	149	148.8	07.3	209	208.8	10.3	269	268.7	13.2
30	30.0	01.5	90	89.9	04.4	150	149.8	07.4	210	209.8	10.3	270	269.7	13.3
31	31.0	01.5	91	90.9	04.5	151	150.8	07.4	211	210.7	10.4	271	270.7	13.3
32	32.0	01.6	92	91.9	04.5	152	151.8	07.5	212	211.7	10.4	272	271.7	13.3
33	33.0	01.6	93	92.9	04.6	153	152.8	07.5	213	212.7	10.5	273	272.7	13.4
34	34.0	01.7	94	93.9	04.6	154	153.8	07.6	214	213.7	10.5	274	273.7	13.4
35	35.0	01.7	95	94.9	04.7	155	154.8	07.6	215	214.7	10.6	275	274.7	13.5
36	36.0	01.8	96	95.9	04.7	156	155.8	07.7	216	215.7	10.6	276	275.7	13.5
37	37.0	01.8	97	96.9	04.8	157	156.8	07.7	217	216.7	10.7	277	276.7	13.6
38	38.0	01.9	98	97.9	04.8	158	157.8	07.8	218	217.7	10.7	278	277.7	13.6
39	39.0	01.9	99	98.9	04.9	159	158.8	07.8	219	218.7	10.8	279	278.7	13.7
40	40.0	02.0	100	99.9	04.9	160	159.8	07.9	220	219.7	10.8	280	279.7	13.7
41	41.0	02.0	101	100.9	05.0	161	160.8	07.9	221	220.7	10.8	281	280.7	13.8
42	41.9	02.1	102	101.9	05.0	162	161.8	08.0	222	221.7	10.9	282	281.7	13.8
43	42.9	02.1	103	102.9	05.1	163	162.8	08.0	223	222.7	10.9	283	282.7	13.9
44	43.9	02.2	104	103.9	05.1	164	163.8	08.1	224	223.7	11.0	284	283.7	13.9
45	44.9	02.2	105	104.9	05.2	165	164.8	08.1	225	224.7	11.0	285	284.7	14.0
46	45.9	02.3	106	105.9	05.2	166	165.8	08.2	226	225.7	11.1	286	285.7	14.0
47	46.9	02.3	107	106.9	05.3	167	166.8	08.2	227	226.7	11.1	287	286.7	14.1
48	47.9	02.4	108	107.9	05.3	168	167.8	08.2	228	227.7	11.2	288	287.7	14.1
49	48.9	02.4	109	108.9	05.4	169	168.8	08.3	229	228.7	11.2	289	288.7	14.2
50	49.9	02.5	110	109.9	05.4	170	169.8	08.3	230	229.7	11.3	290	289.7	14.2
51	50.9	02.5	111	110.9	05.5	171	170.8	08.4	231	230.7	11.3	291	290.7	14.3
52	51.9	02.6	112	111.9	05.5	172	171.8	08.4	232	231.7	11.4	292	291.7	14.3
53	52.9	02.6	113	112.9	05.5	173	172.8	08.5	233	232.7	11.4	293	292.7	14.4
54	53.9	02.7	114	113.9	05.6	174	173.8	08.5	234	233.7	11.5	294	293.6	14.4
55	54.9	02.7	115	114.9	05.6	175	174.8	08.6	235	234.7	11.5	295	294.6	14.5
56	55.9	02.8	116	115.9	05.7	176	175.8	08.6	236	235.7	11.6	296	295.6	14.5
57	56.9	02.8	117	116.9	05.7	177	176.8	08.7	237	236.7	11.6	297	296.6	14.6
58	57.9	02.9	118	117.9	05.8	178	177.8	08.7	238	237.7	11.7	298	297.6	14.6
59	58.9	02.9	119	118.9	05.8	179	178.8	08.8	239	238.7	11.7	299	298.6	14.7
60	59.9	02.9	120	119.9	05.9	180	179.8	08.8	240	239.7	11.8	300	299.6	14.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 7 ¾ Points.

TABLE I.

Difference of Latitude and Departure for ½ Point.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.7	06.0	121	120.4	11.9	181	180.1	17.7	241	239.8	23.6
2	02.0	00.2	62	61.7	06.1	122	121.4	12.0	182	181.1	17.8	242	240.8	23.7
3	03.0	00.3	63	62.7	06.2	123	122.4	12.1	183	182.1	17.9	243	241.8	23.8
4	04.0	00.4	64	63.7	06.3	124	123.4	12.2	184	183.1	18.0	244	242.8	23.9
5	05.0	00.5	65	64.7	06.4	125	124.4	12.3	185	184.1	18.1	245	243.8	24.0
6	06.0	00.6	66	65.7	06.5	126	125.4	12.3	186	185.1	18.2	246	244.8	24.1
7	07.0	00.7	67	66.7	06.6	127	126.4	12.4	187	186.1	18.3	247	245.8	24.2
8	08.0	00.8	68	67.7	06.7	128	127.4	12.5	188	187.1	18.4	248	246.8	24.3
9	09.0	00.9	69	68.7	06.8	129	128.4	12.6	189	188.1	18.5	249	247.8	24.4
10	10.0	01.0	70	69.7	06.9	130	129.4	12.7	190	189.1	18.6	250	248.8	24.5
11	10.9	01.1	71	70.7	07.0	131	130.4	12.8	191	190.1	18.7	251	249.8	24.6
12	11.9	01.2	72	71.7	07.1	132	131.4	12.9	192	191.1	18.8	252	250.8	24.7
13	12.9	01.3	73	72.7	07.2	133	132.4	13.0	193	192.1	18.9	253	251.8	24.8
14	13.9	01.4	74	73.6	07.3	134	133.4	13.1	194	193.1	19.0	254	252.8	24.9
15	14.9	01.5	75	74.6	07.4	135	134.3	13.2	195	194.1	19.1	255	253.8	25.0
16	15.9	01.6	76	75.6	07.4	136	135.3	13.3	196	195.1	19.2	256	254.8	25.1
17	16.9	01.7	77	76.6	07.5	137	136.3	13.4	197	196.1	19.3	257	255.8	25.2
18	17.9	01.8	78	77.6	07.6	138	137.3	13.5	198	197.0	19.4	258	256.8	25.3
19	18.9	01.9	79	78.6	07.7	139	138.3	13.6	199	198.0	19.5	259	257.8	25.4
20	19.9	02.0	80	79.6	07.8	140	139.3	13.7	200	199.0	19.6	260	258.7	25.5
21	20.9	02.1	81	80.6	07.9	141	140.3	13.8	201	200.0	19.7	261	259.7	25.6
22	21.9	02.2	82	81.6	08.0	142	141.3	13.9	202	201.0	19.8	262	260.7	25.7
23	22.9	02.3	83	82.6	08.1	143	142.3	14.0	203	202.0	19.9	263	261.7	25.8
24	23.9	02.4	84	83.6	08.2	144	143.3	14.1	204	203.0	20.0	264	262.7	25.9
25	24.9	02.4	85	84.6	08.3	145	144.3	14.2	205	204.0	20.1	265	263.7	26.0
26	25.9	02.5	86	85.6	08.4	146	145.3	14.3	206	205.0	20.2	266	264.7	26.1
27	26.9	02.6	87	86.6	08.5	147	146.3	14.4	207	206.0	20.3	267	265.7	26.2
28	27.9	02.7	88	87.6	08.6	148	147.3	14.5	208	207.0	20.4	268	266.7	26.3
29	28.9	02.8	89	88.6	08.7	149	148.3	14.6	209	208.0	20.5	269	267.7	26.4
30	29.9	02.9	90	89.6	08.8	150	149.3	14.7	210	209.0	20.6	270	268.7	26.5
31	30.9	03.0	91	90.6	08.9	151	150.3	14.8	211	210.0	20.7	271	269.7	26.6
32	31.8	03.1	92	91.6	09.0	152	151.3	14.9	212	211.0	20.8	272	270.7	26.7
33	32.8	03.2	93	92.6	09.1	153	152.3	15.0	213	212.0	20.9	273	271.7	26.8
34	33.8	03.3	94	93.6	09.2	154	153.3	15.1	214	213.0	21.0	274	272.7	26.9
35	34.8	03.4	95	94.5	09.3	155	154.3	15.2	215	214.0	21.1	275	273.7	27.0
36	35.8	03.5	96	95.5	09.4	156	155.2	15.3	216	215.0	21.2	276	274.7	27.1
37	36.8	03.6	97	96.5	09.5	157	156.2	15.4	217	216.0	21.3	277	275.7	27.2
38	37.8	03.7	98	97.5	09.6	158	157.2	15.5	218	216.9	21.4	278	276.7	27.3
39	38.8	03.8	99	98.5	09.7	159	158.2	15.6	219	217.9	21.5	279	277.7	27.3
40	39.8	03.9	100	99.5	09.8	160	159.2	15.7	220	218.9	21.6	280	278.7	27.4
41	40.8	04.0	101	100.5	09.9	161	160.2	15.8	221	219.9	21.7	281	279.6	27.5
42	41.8	04.1	102	101.5	10.0	162	161.2	15.9	222	220.9	21.8	282	280.6	27.6
43	42.8	04.2	103	102.5	10.1	163	162.2	16.0	223	221.9	21.9	283	281.6	27.7
44	43.8	04.3	104	103.5	10.2	164	163.2	16.1	224	222.9	22.0	284	282.6	27.8
45	44.8	04.4	105	104.5	10.3	165	164.2	16.2	225	223.9	22.1	285	283.6	27.9
46	45.8	04.5	106	105.5	10.4	166	165.2	16.3	226	224.9	22.2	286	284.6	28.0
47	46.8	04.6	107	106.5	10.5	167	166.2	16.4	227	225.9	22.2	287	285.6	28.1
48	47.8	04.7	108	107.5	10.6	168	167.2	16.5	228	226.9	22.3	288	286.6	28.2
49	48.8	04.8	109	108.5	10.7	169	168.2	16.6	229	227.9	22.4	289	287.6	28.3
50	49.8	04.9	110	109.5	10.8	170	169.2	16.7	230	228.9	22.5	290	288.6	28.4
51	50.8	05.0	111	110.5	10.9	171	170.2	16.8	231	229.9	22.6	291	289.6	28.5
52	51.7	05.1	112	111.5	11.0	172	171.2	16.9	232	230.9	22.7	292	290.6	28.6
53	52.7	05.2	113	112.5	11.1	173	172.2	17.0	233	231.9	22.8	293	291.6	28.7
54	53.7	05.3	114	113.5	11.2	174	173.2	17.1	234	232.9	22.9	294	292.6	28.8
55	54.7	05.4	115	114.5	11.3	175	174.2	17.2	235	233.9	23.0	295	293.6	28.9
56	55.7	05.5	116	115.4	11.4	176	175.2	17.3	236	234.9	23.1	296	294.6	29.0
57	56.7	05.6	117	116.4	11.5	177	176.1	17.4	237	235.9	23.2	297	295.6	29.1
58	57.7	05.7	118	117.4	11.6	178	177.1	17.4	238	236.9	23.3	298	296.6	29.2
59	58.7	05.8	119	118.4	11.7	179	178.1	17.5	239	237.8	23.4	299	297.6	29.3
60	59.7	05.9	120	119.4	11.8	180	179.1	17.6	240	238.8	23.5	300	298.6	29.4
Dist	**Dep.**	**Lat.**	**Dist**	**Dep.**	**Lat.**	**Dist**	**Dep.**	**Lat.**	**Dist**	**Dep.**	**Lat.**	**Dist**	**Dep.**	**Lat.**

for 7 ½ Points.

TABLE I.

Difference of Latitude and Departure for ¾ Point.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.3	08.9	121	119.7	17.7	181	179.0	26.6	241	238.4	35.4
2	02.0	00.3	62	61.3	09.1	122	120.7	17.9	182	180.0	26.7	242	239.4	35.5
3	03.0	00.4	63	62.3	09.2	123	121.7	18.0	183	181.0	26.8	243	240.4	35.7
4	04.0	00.6	64	63.3	09.4	124	122.7	18.2	184	182.0	27.0	244	241.4	35.8
5	04.9	00.7	65	64.3	09.5	125	123.6	18.3	185	183.0	27.1	245	242.3	35.9
6	05.9	00.9	66	65.3	09.7	126	124.6	18.5	186	184.0	27.3	246	243.3	36.1
7	06.9	01.0	67	66.3	09.8	127	125.6	18.6	187	185.0	27.4	247	244.3	36.2
8	07.9	01.2	68	67.3	10.0	128	126.6	18.8	188	186.0	27.6	248	245.3	36.4
9	08.9	01.3	69	68.2	10.1	129	127.6	18.9	189	186.9	27.7	249	246.3	36.5
10	09.9	01.5	70	69.2	10.3	130	128.6	19.1	190	187.9	27.9	250	247.3	36.7
11	10.9	01.6	71	70.2	10.4	131	129.6	19 2	191	188.9	28.0	251	248.3	36.8
12	11.9	01.8	72	71.2	10.6	132	130.6	19.4	192	189.9	28.2	252	249.3	37.0
13	12.9	01.9	73	72.2	10.7	133	131.6	19.5	193	190.9	28.3	253	250.3	37.1
14	13.8	02.1	74	73.2	10.9	134	132.5	19.7	194	191.9	28.5	254	251.2	37.3
15	14.8	02.2	75	74.2	11.0	135	133.5	19.8	195	192.9	28.6	255	252.2	37.4
16	15.8	02.3	76	75.2	11.1	136	134.5	20.0	196	193.9	28.8	256	253.2	37.6
17	16.8	02.5	77	76.2	11.3	137	135.5	20.1	197	194.9	28.9	257	254.2	37.7
18	17.8	02.6	78	77.2	11.4	138	136.5	20.2	198	195.9	29.0	258	255.2	37.9
19	18.8	02.8	79	78.1	11.6	139	137.5	20.4	199	196.8	29.2	259	256.2	38.0
20	19.8	02.9	80	79.1	11.7	140	138.5	20.5	200	197.8	29.3	260	257.2	38.1
21	20.8	03.1	81	80.1	11.9	141	139.5	20.7	201	198.8	29.5	261	258.2	38.3
22	21.8	03.2	82	81.1	12.0	142	140.5	20.8	202	199.8	29.6	262	259.2	38.4
23	22.7	03.4	83	82.1	12.2	143	141.4	21.0	203	200.8	29.8	263	260.1	38.6
24	23.7	03.5	84	83.1	12.3	144	142.4	21.1	204	201.8	29.9	264	261.1	38.7
25	24.7	03.7	85	84.1	12.5	145	143.4	21.3	205	202.8	30.1	265	262.1	38.9
26	25.7	03.8	86	85.1	12.6	146	144.4	21.4	206	203.8	30.2	266	263.1	39 0
27	26.7	04.0	87	86.1	12.8	147	145.4	21.6	207	204.8	30.4	267	264.1	39.2
28	27.7	04.1	88	87.0	12.9	148	146.4	21.7	208	205.7	30.5	268	265.1	39.3
29	28.7	04.3	89	88.0	13.1	149	147.4	21.9	209	206.7	30.7	269	266.1	39.5
30	29.7	04.4	90	89.0	13.2	150	148.4	22.0	210	207.7	30.8	270	267.1	39.6
31	30.7	04.5	91	90.0	13.3	151	149.4	22.2	211	208.7	30.9	271	268.1	39.8
32	31.7	04.7	92	91.0	13.5	152	150.3	22.3	212	209.7	31.1	272	269.0	39.9
33	32.6	04.8	93	92.0	13.6	153	151.3	22.4	213	210.7	31.2	273	270.0	40.1
34	33.6	05.0	94	93.0	13.8	154	152.3	22.6	214	211.7	31.4	274	271.0	40.2
35	34.6	05.1	95	94.0	13.9	155	153.3	22.7	215	212.7	31.5	275	272.0	40.3
36	35.6	05.3	96	95.0	14.1	156	154.3	22.9	216	213.7	31.7	276	273.0	40.5
37	36.6	05.4	97	95.9	14.2	157	155.3	23.0	217	214.6	31.8	277	274.0	40.6
38	37.6	05.6	98	96.9	14.4	158	156.3	23.2	218	215.6	32.0	278	275.0	40.8
39	38.6	05.7	99	97.9	14.5	159	157.3	23.3	219	216.6	32.1	279	276.0	40.9
40	39.6	05.9	100	98.9	14.7	160	158.3	23.5	220	217.6	32.3	280	277.0	41.1
41	40.6	06.0	101	99.9	14.8	161	159.3	23.6	221	218.6	32.4	281	278.0	41.2
42	41.5	06.2	102	100.9	15.0	162	160.2	23.8	222	219.6	32.6	282	278.9	41.4
43	42.5	06.3	103	101.9	15.1	163	161.2	23.9	223	220.6	32.7	283	279.9	41.5
44	43.5	06.5	104	102.9	15.3	164	162.2	24.1	224	221.6	32.9	284	280.9	41.7
45	44.5	06.6	105	103.9	15.4	165	163.2	24.2	225	222.6	33.0	285	281.9	41.8
46	45.5	06.7	106	104.8	15.5	166	164.2	24.4	226	223.5	33.2	286	282.9	42.0
47	46.5	06.9	107	105.8	15.7	167	165.2	24.5	227	224.5	33.3	287	283.9	42.1
48	47.5	07.0	108	106.8	15.8	168	166.2	24.6	228	225.5	33.4	288	284.9	42.3
49	48.5	07.2	109	107.8	16.0	169	167.2	24.8	229	226.5	33.6	289	285.9	42.4
50	49.5	07.3	110	108.8	16.1	170	168.2	24.9	230	227.5	33.7	290	286.9	42.5
51	50.4	07.5	111	109.8	16.3	171	169.1	25.1	231	228.5	33.9	291	287.8	42.7
52	51.4	07.6	112	110.8	16.4	172	170.1	25.2	232	229.5	34.0	292	288.8	42.8
53	52.4	07.8	113	111.8	16.6	173	171.1	25.4	233	230.5	34.2	293	289.8	43.0
54	53.4	07.9	114	112.8	16.7	174	172.1	25.5	234	231.5	34.3	294	290.8	43.1
55	54.4	08.1	115	113.7	16.9	175	173.1	25.7	235	232.4	34.5	295	291.8	43.3
56	55.4	08.2	116	114.7	17.0	176	174.1	25.8	236	233.4	34.6	296	292.8	43.4
57	56.4	08.4	117	115.7	17.2	177	175.1	26.0	237	234.4	34.8	297	293.8	43.6
58	57.4	08.5	118	116.7	17.3	178	176.1	26.1	238	235.4	34.9	298	294.8	43.7
59	58.4	08.7	119	117.7	17.5	179	177.1	26.3	239	236.4	35.1	299	295.8	43.9
60	59.3	08.8	120	118.7	17 6	180	178.0	26.4	240	237.4	35.2	300	296.8	44.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 7¼ Points.

TABLE I.

Difference of Latitude and Departure for 1 Point.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.8	11.9	121	118.7	23.6	181	177.5	35.3	241	236.4	47.0
2	02.0	00.4	62	60.8	12.1	122	119.7	23.8	182	178.5	35.5	242	237.3	47.2
3	02.9	00.6	63	61.8	12.3	123	120.6	24.0	183	179.5	35.7	243	238.3	47.4
4	03.9	00.8	64	62.8	12.5	124	121.6	24.2	184	180.5	35.9	244	239.3	47.6
5	04.9	01.0	65	63.7	12.7	125	122.6	24.4	185	181.4	36.1	245	240.3	47.8
6	05.9	01.2	66	64.7	12.9	126	123.6	24.6	186	182.4	36.3	246	241.3	48.0
7	06.9	01.4	67	65.7	13.1	127	124.6	24.8	187	183.4	36.5	247	242.3	48.2
8	07.8	01.6	68	66.7	13.3	128	125.5	25.0	188	184.4	36.7	248	243.2	48.4
9	08.8	01.8	69	67.7	13.5	129	126.5	25.2	189	185.4	36.9	249	244.2	48.6
10	09.8	02.0	70	68.7	13.7	130	127.5	25.4	190	186.3	37.1	250	245.2	48.8
11	10.8	02.1	71	69.6	13.9	131	128.5	25.6	191	187.3	37.3	251	246.2	49.0
12	11.8	02.3	72	70.6	14.0	132	129.5	25.8	192	188.3	37.5	252	247.2	49.2
13	12.7	02.5	73	71.6	14.2	133	130.4	26.0	193	189.3	37.7	253	248.1	49.4
14	13.7	02.7	74	72.6	14.4	134	131.4	26.1	194	190.3	37.8	254	249.1	49.6
15	14.7	02.9	75	73.6	14.6	135	132.4	26.3	195	191.2	38.0	255	250.1	49.7
16	15.7	03.1	76	74.5	14.8	136	133.4	26.5	196	192.2	38.2	256	251.1	49.9
17	16.7	03.3	77	75.5	15.0	137	134.4	26.7	197	193.2	38.4	257	252.1	50.1
18	17.7	03.5	78	76.5	15.2	138	135.3	26.9	198	194.2	38.6	258	253.0	50.3
19	18.6	03.7	79	77.5	15.4	139	136.3	27.1	199	195.2	38.8	259	254.0	50.5
20	19.6	03.9	80	78.5	15.6	140	137.3	27.3	200	196.2	39.0	260	255.0	50.7
21	20.6	04.1	81	79.4	15.8	141	138.3	27.5	201	197.1	39.2	261	256.0	50.9
22	21.6	04.3	82	80.4	16.0	142	139.3	27.7	202	198.1	39.4	262	257.0	51.1
23	22.6	04.5	83	81.4	16.2	143	140.2	27.9	203	199.1	39.6	263	257.9	51.3
24	23.5	04.7	84	82.4	16.4	144	141.2	28.1	204	200.1	39.8	264	258.9	51.5
25	24.5	04.9	85	83.4	16.6	145	142.2	28.3	205	201.1	40.0	265	259.9	51.7
26	25.5	05.1	86	84.3	16.8	146	143.2	28.5	206	202.0	40.2	266	260.9	51.9
27	26.5	05.3	87	85.3	17.0	147	144.2	28.7	207	203.0	40.4	267	261.9	52.1
28	27.5	05.5	88	86.3	17.2	148	145.2	28.9	208	204.0	40.6	268	262.8	52.3
29	28.4	05.7	89	87.3	17.4	149	146.1	29.1	209	205.0	40.8	269	263.8	52.5
30	29.4	05.9	90	88.3	17.6	150	147.1	29.3	210	206.0	41.0	270	264.8	52.7
31	30.4	06.0	91	89.2	17.8	151	148.1	29.5	211	206.9	41.2	271	265.8	52.9
32	31.4	06.2	92	90.2	18.0	152	149.1	29.7	212	207.9	41.4	272	266.8	53.1
33	32.4	06.4	93	91.2	18.1	153	150.1	29.9	213	208.9	41.6	273	267.8	53.3
34	33.3	06.6	94	92.2	18.3	154	151.0	30.0	214	209.9	41.7	274	268.7	53.5
35	34.3	06.8	95	93.2	18.5	155	152.0	30.2	215	210.9	41.9	275	269.7	53.6
36	35.3	07.0	96	94.2	18.7	156	153.0	30.4	216	211.8	42.1	276	270.7	53.8
37	36.3	07.2	97	95.1	18.9	157	154.0	30.6	217	212.8	42.3	277	271.7	54.0
38	37.3	07.4	98	96.1	19.1	158	155.0	30.8	218	213.8	42.5	278	272.7	54.2
39	38.2	07.6	99	97.1	19.3	159	155.9	31.0	219	214.8	42.7	279	273.6	54.4
40	39.2	07.8	100	98.1	19.5	160	156.9	31.2	220	215.8	42.9	280	274.6	54.6
41	40.2	08.0	101	99.1	19.7	161	157.9	31.4	221	216.7	43.1	281	275.6	54.8
42	41.2	08.2	102	100.0	19.9	162	158.9	31.6	222	217.7	43.3	282	276.6	55.0
43	42.2	08.4	103	101.0	20.1	163	159.9	31.8	223	218.7	43.5	283	277.6	55.2
44	43.2	08.6	104	102.0	20.3	164	160.8	32.0	224	219.7	43.7	284	278.5	55.4
45	44.1	08.8	105	103.0	20.5	165	161.8	32.2	225	220.7	43.9	285	279.5	55.6
46	45.1	09.0	106	104.0	20.7	166	162.8	32.4	226	221.7	44.1	286	280.5	55.8
47	46.1	09.2	107	104.9	20.9	167	163.8	32.6	227	222.6	44.3	287	281.5	56.0
48	47.1	09.4	108	105.9	21.1	168	164.8	32.8	228	223.6	44.5	288	282.5	56.2
49	48.1	09.6	109	106.9	21.3	169	165.7	33.0	229	224.6	44.7	289	283.4	56.4
50	49.0	09.8	110	107.9	21.5	170	166.7	33.2	230	225.6	44.9	290	284.4	56.6
51	50.0	10.0	111	108.9	21.7	171	167.7	33.4	231	226.6	45.1	291	285.4	56.8
52	51.0	10.1	112	109.8	21.9	172	168.7	33.6	232	227.5	45.3	292	286.4	57.0
53	52.0	10.3	113	110.8	22.0	173	169.7	33.8	233	228.5	45.5	293	287.4	57.2
54	53.0	10.5	114	111.8	22.2	174	170.7	34.0	234	229.5	45.7	294	288.3	57.4
55	53.9	10.7	115	112.8	22.4	175	171.6	34.1	235	230.5	45.8	295	289.3	57.6
56	54.9	10.9	116	113.8	22.6	176	172.6	34.3	236	231.5	46.0	296	290.3	57.7
57	55.9	11.1	117	114.7	22.8	177	173.6	34.5	237	232.4	46.2	297	291.3	57.9
58	56.9	11.3	118	115.7	23.0	178	174.6	34.7	238	233.4	46.4	298	292.3	58.1
59	57.9	11.5	119	116.7	23.2	179	175.6	34.9	239	234.4	46.6	299	293.3	58.3
60	58.8	11.7	120	117.7	23.4	180	176.5	35.1	240	235.4	46.8	300	294.2	58.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 7 Points.

TABLE I.

Difference of Latitude and Departure for 1 ¼ Point.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.2	14.8	121	117.4	29.4	181	175.6	44.0	241	233.8	58.6
2	01.9	00.5	62	60.1	15.1	122	118.3	29.6	182	176.5	44.2	242	234.7	58.8
3	02.9	00.7	63	61.1	15.3	123	119.3	29.9	183	177.5	44.5	243	235.7	59.0
4	03.9	01.0	64	62.1	15.6	124	120.3	30.1	184	178.5	44.7	244	236.7	59.3
5	04.9	01.2	65	63.1	15.8	125	121.3	30.4	185	179.5	45.0	245	237.7	59.5
6	05.8	01.5	66	64.0	16.0	126	122.2	30.6	186	180.4	45.2	246	238.6	59.8
7	06.8	01.7	67	65.0	16.3	127	123.2	30.9	187	181.4	45.4	247	239.6	60.0
8	07.8	01.9	68	66.0	16.5	128	124.2	31.1	188	182.4	45.7	248	240.6	60.3
9	08.7	02.2	69	66.9	16.8	129	125.1	31.3	189	183.3	45.9	249	241.5	60.5
10	09.7	02.4	70	67.9	17.0	130	126.1	31.6	190	184.3	46.2	250	242.5	60.7
11	10.7	02.7	71	68.9	17.3	131	127.1	31.8	191	185.3	46.4	251	243.5	61.0
12	11.6	02.9	72	69.8	17.5	132	128.0	32.1	192	186.2	46.7	252	244.5	61.2
13	12.6	03.2	73	70.8	17.7	133	129.0	32.3	193	187.2	46.9	253	245.4	61.5
14	13.6	03.4	74	71.8	18.0	134	130.0	32.6	194	188.2	47.1	254	246.4	61.7
15	14.6	03.6	75	72.8	18.2	135	131.0	32.8	195	189.2	47.4	255	247.4	62.0
16	15.5	03.9	76	73.7	18.5	136	131.9	33.0	196	190.1	47.6	256	248.3	62.2
17	16.5	04.1	77	74.7	18.7	137	132.9	33.3	197	191.1	47.9	257	249.3	62.5
18	17.5	04.4	78	75.7	19.0	138	133.9	33.5	198	192.1	48.1	258	250.3	62.7
19	18.4	04.6	79	76.6	19.2	139	134.8	33.8	199	193.0	48.4	259	251.2	62.9
20	19.4	04.9	80	77.6	19.4	140	135.8	34.0	200	194.0	48.6	260	252.2	63.2
21	20.4	05.1	81	78.6	19.7	141	136.8	34.3	201	195.0	48.8	261	253.2	63.4
22	21.3	05.3	82	79.5	19.9	142	137.7	34.5	202	195.9	49.1	262	254.2	63.7
23	22.3	05.6	83	80.5	20.2	143	138.7	34.7	203	196.9	49.3	263	255.1	63.9
24	23.3	05.8	84	81.5	20.4	144	139.7	35.0	204	197.9	49.6	264	256.1	64.2
25	24.3	06.1	85	82.5	20.7	145	140.7	35.2	205	198.9	49.8	265	257.1	64.4
26	25.2	06.3	86	83.4	20.9	146	141.6	35.5	206	199.8	50.1	266	258.0	64.6
27	26.2	06.6	87	84.4	21.1	147	142.6	35.7	207	200.8	50.3	267	259.0	64.9
28	27.2	06.8	88	85.4	21.4	148	143.6	36.0	208	201.8	50.5	268	260.0	65.1
29	28.1	07.0	89	86.3	21.6	149	144.5	36.2	209	202.7	50.8	269	260.9	65.4
30	29.1	07.3	90	87.3	21.9	150	145.5	36.5	210	203.7	51.0	270	261.9	65.6
31	30.1	07.5	91	88.3	22.1	151	146.5	36.7	211	204.7	51.3	271	262.9	65.9
32	31.0	07.8	92	89.2	22.4	152	147.4	36.9	212	205.6	51.5	272	263.9	66.1
33	32.0	08.0	93	90.2	22.6	153	148.4	37.2	213	206.6	51.8	273	264.8	66.3
34	33.0	08.3	94	91.2	22.8	154	149.4	37.4	214	207.6	52.0	274	265.8	66.6
35	34.0	08.5	95	92.2	23.1	155	150.4	37.7	215	208.6	52.2	275	266.8	66.8
36	34.9	08.7	96	93.1	23.3	156	151.3	37.9	216	209.5	52.5	276	267.7	67.1
37	35.9	09.0	97	94.1	23.6	157	152.3	38.2	217	210.5	52.7	277	268.7	67.3
38	36.9	09.2	98	95.1	23.8	158	153.3	38.4	218	211.5	53.0	278	269.7	67.6
39	37.8	09.5	99	96.0	24.1	159	154.2	38.6	219	212.4	53.2	279	270.6	67.8
40	38.8	09.7	100	97.0	24.3	160	155.2	38.9	220	213.4	53.5	280	271.6	68.0
41	39.8	10.0	101	98.0	24.5	161	156.2	39.1	221	214.4	53.7	281	272.6	68.3
42	40.7	10.2	102	98.9	24.8	162	157.1	39.4	222	215.4	53.9	282	273.6	68.5
43	41.7	10.4	103	99.9	25.0	163	158.1	39.6	223	216.3	54.2	283	274.5	68.8
44	42.7	10.7	104	100.9	25.3	164	159.1	39.9	224	217.3	54.4	284	275.5	69.0
45	43.7	10.9	105	101.9	25.5	165	160.1	40.1	225	218.3	54.7	285	276.5	69.3
46	44.6	11.2	106	102.8	25.8	166	161.0	40.3	226	219.2	54.9	286	277.4	69.5
47	45.6	11.4	107	103.8	26.0	167	162.0	40.6	227	220.2	55.2	287	278.4	69.7
48	46.6	11.7	108	104.8	26.2	168	163.0	40.8	228	221.2	55.4	288	279.4	70.0
49	47.5	11.9	109	105.7	26.5	169	163.9	41.1	229	222.1	55.6	289	280.3	70.2
50	48.5	12.2	110	106.7	26.7	170	164.9	41.3	230	223.1	55.9	290	281.3	70.5
51	49.5	12.4	111	107.7	27.0	171	165.9	41.6	231	224.1	56.1	291	282.3	70.7
52	50.4	12.6	112	108.6	27.2	172	166.8	41.8	232	225.1	56.4	292	283.3	71.0
53	51.4	12.9	113	109.6	27.5	173	167.8	42.0	233	226.0	56.6	293	284.2	71.2
54	52.4	13.1	114	110.6	27.7	174	168.8	42.3	234	227.0	56.9	294	285.2	71.4
55	53.4	13.4	115	111.6	27.9	175	169.8	42.5	235	228.0	57.1	295	286.2	71.7
56	54.3	13.6	116	112.5	28.2	176	170.7	42.8	236	228.9	57.3	296	287.1	71.9
57	55.3	13.9	117	113.5	28.4	177	171.7	43.0	237	229.9	57.6	297	288.1	72.2
58	56.3	14.1	118	114.5	28.7	178	172.7	43.3	238	230.9	57.8	298	289.1	72.4
59	57.2	14.3	119	115.4	28.9	179	173.6	43.5	239	231.8	58.1	299	290.0	72.7
60	58.2	14.6	120	116.4	29.2	180	174.6	43.7	240	232.8	58.3	300	291.0	72.9
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 6 ¾ Points.

TABLE I

Difference of Latitude and Departure for 1 ½ Point.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.4	17.7	121	115.8	35.1	181	173.2	52.5	241	230.6	70.0
2	01.9	00.6	62	59.3	18.0	122	116.8	35.4	182	174.2	52.8	242	231.6	70.2
3	02.9	00.9	63	60.3	18.3	123	117.7	35.7	183	175.1	53.1	243	232.5	70.5
4	03.8	01.2	64	61.2	18.6	124	118.7	36.0	184	176.1	53.4	244	233.5	70.8
5	04.8	01.5	65	62.2	18.9	125	119.6	36.3	185	177.0	53.7	245	234.5	71.1
6	05.7	01.7	66	63.2	19.2	126	120.6	36.6	186	178.0	54.0	246	235.4	71.4
7	06.7	02.0	67	64.1	19.4	127	121.5	36.9	187	179.0	54.3	247	236.4	71.7
8	07.7	02.3	68	65.1	19.7	128	122.5	37.2	188	179.9	54.6	248	237.3	72.0
9	08.6	02.6	69	66.0	20.0	129	123.5	37.4	189	180.9	54.9	249	238.3	72.3
10	09.6	02.9	70	67.0	20.3	130	124.4	37.7	190	181.8	55.1	250	239.2	72.6
11	10.5	03.2	71	67.9	20.6	131	125.4	38.0	191	182.8	55.4	251	240.2	72.9
12	11.5	03.5	72	68.9	20.9	132	126.3	38.3	192	183.7	55.7	252	241.2	73.1
13	12.4	03.8	73	69.9	21.2	133	127.3	38.6	193	184.7	56.0	253	242.1	73.4
14	13.4	04.1	74	70.8	21.5	134	128.2	38.9	194	185.7	56.3	254	243.1	73.7
15	14.4	04.4	75	71.8	21.8	135	129.2	39.2	195	186.6	56.6	255	244.0	74.0
16	15.3	04.6	76	72.7	22.1	136	130.1	39.5	196	187.6	56.9	256	245.0	74.3
17	16.3	04.9	77	73.7	22.3	137	131.1	39.8	197	188.5	57.2	257	245.9	74.6
18	17.2	05.2	78	74.6	22.6	138	132.1	40.1	198	189.5	57.5	258	246.9	74.9
19	18.2	05.5	79	75.6	22.9	139	133.0	40.3	199	190.4	57.8	259	247.9	75.2
20	19.1	05.8	80	76.6	23.2	140	134.0	40.6	200	191.4	58.1	260	248.8	75.5
21	20.1	06.1	81	77.5	23.5	141	134.9	40.9	201	192.3	58.4	261	249.8	75.8
22	21.1	06.4	82	78.5	23.8	142	135.9	41.2	202	193.3	58.6	262	250.7	76.0
23	22.0	06.7	83	79.4	24.1	143	136.8	41.5	203	194.3	58.9	263	251.7	76.3
24	23.0	07.0	84	80.4	24.4	144	137.8	41.8	204	195.2	59.2	264	252.6	76.6
25	23.9	07.3	85	81.3	24.7	145	138.8	42.1	205	196.2	59.5	265	253.6	76.9
26	24.9	07.5	86	82.3	25.0	146	139.7	42.4	206	197.1	59.8	266	254.6	77.2
27	25.8	07.8	87	83.3	25.2	147	140.7	42.7	207	198.1	60.1	267	255.5	77.5
28	26.8	08.1	88	84.2	25.5	148	141.6	43.0	208	199.0	60.4	268	256.5	77.8
29	27.8	08.4	89	85.2	25.8	149	142.6	43.2	209	200.0	60.7	269	257.4	78.1
30	28.7	08.7	90	86.1	26.1	150	143.5	43.5	210	201.0	61.0	270	258.4	78.4
31	29.7	09.0	91	87.1	26.4	151	144.5	43.8	211	201.9	61.2	271	259.3	78.7
32	30.6	09.3	92	88.0	26.7	152	145.5	44.1	212	202.9	61.5	272	260.3	79.0
33	31.6	09.6	93	89.0	27.0	153	146.4	44.4	213	203.8	61.8	273	261.2	79.2
34	32.5	09.9	94	90.0	27.3	154	147.4	44.7	214	204.8	62.1	274	262.2	79.5
35	33.5	10.2	95	90.9	27.6	155	148.3	45.0	215	205.7	62.4	275	263.2	79.8
36	34.5	10.4	96	91.9	27.9	156	149.3	45.3	216	206.7	62.7	276	264.1	80.1
37	35.4	10.7	97	92.8	28.2	157	150.2	45.6	217	207.7	63.0	277	265.1	80.4
38	36.4	11.0	98	93.8	28.4	158	151.2	45.9	218	208.6	63.3	278	266.0	80.7
39	37.3	11.3	99	94.7	28.7	159	152.2	46.1	219	209.6	63.6	279	267.0	81.0
40	38.2	11.6	100	95.7	29.0	160	153.1	46.4	220	210.5	63.9	280	267.9	81.3
41	39.2	11.9	101	96.7	29.3	161	154.1	46.7	221	211.5	64.1	281	268.9	81.6
42	40.2	12.2	102	97.6	29.6	162	155.0	47.0	222	212.4	64.4	282	269.9	81.9
43	41.2	12.5	103	98.6	29.9	163	156.0	47.3	223	213.4	64.7	283	270.8	82.1
44	42.1	12.8	104	99.5	30.2	164	156.9	47.6	224	214.4	65.0	284	271.8	82.4
45	43.1	13.1	105	100.5	30.5	165	157.9	47.9	225	215.3	65.3	285	272.7	82.7
46	44.0	13.3	106	101.4	30.8	166	158.9	48.2	226	216.3	65.6	286	273.7	83.0
47	45.0	13.6	107	102.4	31.1	167	159.8	48.5	227	217.2	65.9	287	274.6	83.3
48	45.9	13.9	108	103.4	31.4	168	160.8	48.8	228	218.2	66.2	288	275.6	83.6
49	46.9	14.2	109	104.3	31.6	169	161.7	49.1	229	219.1	66.5	289	276.6	83.9
50	47.9	14.5	110	105.3	31.9	170	162.7	49.3	230	220.1	66.8	290	277.5	84.2
51	48.8	14.8	111	106.2	32.2	171	163.6	49.6	231	221.1	67.0	291	278.5	84.5
52	49.8	15.1	112	107.2	32.5	172	164.6	49.9	232	222.0	67.3	292	79.4	84.8
53	50.7	15.4	113	108.1	32.8	173	165.6	50.2	233	223.0	67.6	293	280.4	85.0
54	51.7	15.7	114	109.1	33.1	174	166.5	50.5	234	223.9	67.9	294	281.3	85.3
55	52.6	16.0	115	110.1	33.4	175	167.5	50.8	235	224.9	68.2	295	282.3	85.6
56	53.6	16.3	116	111.0	33.7	176	168.4	51.1	236	225.8	68.5	296	283.3	85.9
57	54.5	16.5	117	112.0	34.0	177	169.4	51.4	237	226.8	68.8	297	284.2	86.2
58	55.5	16.8	118	112.9	34.2	178	170.3	51.7	238	227.8	69.1	298	285.2	86.5
59	56.5	17.1	119	113.9	34.5	179	171.3	52.0	239	228.7	69.4	299	286.1	86.8
60	57.4	17.4	120	114.8	34.8	180	172.3	52.2	240	229.7	69.7	300	287.1	87.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 6 ½ Points.

TABLE I.

Difference of Latitude and Departure for 1 ¾ Point.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.3	61	57.4	20.5	121	113.9	40.8	181	170.4	61.0	241	226.9	81.2
2	01.9	00.7	62	58.4	20.9	122	114.9	41.1	182	171.4	61.3	242	227.8	81.5
3	02.8	01.0	63	59.3	21.2	123	115.8	41.4	183	172.3	61.6	243	228.8	81.9
4	03.8	01.3	64	60.3	21.6	124	116.7	41.8	184	173.2	62.0	244	229.7	82.2
5	04.7	01.7	65	61.2	21.9	125	117.7	42.1	185	174.2	62.3	245	230.7	82.5
6	05.6	02.0	66	62.1	22.2	126	118.6	42.4	186	175.1	62.7	246	231.6	82.9
7	06.6	02.4	67	63.1	22.6	127	119.6	42.8	187	176.1	63.0	247	232.6	83.2
8	07.5	02.7	68	64.0	22.9	128	120.5	43.1	188	177.0	63.3	248	233.5	83.5
9	08.5	03.0	69	65.0	23.2	129	121.5	43.5	189	177.9	63.7	249	234.4	83.9
10	09.4	03.4	70	65.9	23.6	130	122.4	43.8	190	178.9	64.0	250	235.4	84.2
11	10.4	03.7	71	66.8	23.9	131	123.3	44.1	191	179.8	64.3	251	236.3	84.6
12	11.3	04.0	72	67.8	24.3	132	124.3	44.5	192	180.8	64.7	252	237.3	84.9
13	12.2	04.4	73	68.7	24.6	133	125.2	44.8	193	181.7	65.0	253	238.2	85.2
14	13.2	04.7	74	69.7	24.9	134	126.2	45.1	194	182.7	65.4	254	239.1	85.6
15	14.1	05.1	75	70.6	25.3	135	127.1	45.5	195	183.6	65.7	255	240.1	85.9
16	15.1	05.4	76	71.6	25.6	136	128.0	45.8	196	184.5	66.0	256	241.0	86.2
17	16.0	05.7	77	72.5	25.9	137	129.0	46.1	197	185.5	66.4	257	242.0	86.6
18	17.0	06.1	78	73.4	26.3	138	129.9	46.5	198	186.4	66.7	258	242.9	86.9
19	17.9	06.4	79	74.4	26.6	139	130.9	46.8	199	187.4	67.0	259	243.9	87.2
20	18.8	06.7	80	75.3	26.9	140	131.8	47.2	200	188.3	67.4	260	244.8	87.6
21	19.8	07.1	81	76.3	27.3	141	132.8	47.5	201	189.2	67.7	261	245.7	87.9
22	20.7	07.4	82	77.2	27.6	142	133.7	47.8	202	190.2	68.0	262	246.7	88.3
23	21.7	07.7	83	78.1	28.0	143	134.6	48.2	203	191.1	68.4	263	247.6	88.6
24	22.6	08.1	84	79.1	28.3	144	135.6	48.5	204	192.1	68.7	264	248.6	88.9
25	23.5	08.4	85	80.0	28.6	145	136.5	48.8	205	193.0	69.1	265	249.5	89.3
26	24.5	08.8	86	81.0	29.0	146	137.5	49.2	206	194.0	69.4	266	250.4	89.6
27	25.4	09.1	87	81.9	29.3	147	138.4	49.5	207	194.9	69.7	267	251.4	89.9
28	26.4	09.4	88	82.9	29.6	148	139.3	49.9	208	195.8	70.1	268	252.3	90.3
29	27.3	09.8	89	83.8	30.0	149	140.3	50.2	209	196.8	70.4	269	253.3	90.6
30	28.2	10.1	90	84.7	30.3	150	141.2	50.5	210	197.7	70.7	270	254.2	91.0
31	29.2	10.4	91	85.7	30.7	151	142.2	50.9	211	198.7	71.1	271	255.2	91.3
32	30.1	10.8	92	86.6	31.0	152	143.1	51.2	212	199.6	71.4	272	256.1	91.6
33	31.1	11.1	93	87.6	31.3	153	144.1	51.5	213	200.5	71.8	273	257.0	92.0
34	32.0	11.5	94	88.5	31.7	154	145.0	51.9	214	201.5	72.1	274	258.0	92.3
35	33.0	11.8	95	89.4	32.0	155	145.9	52.2	215	202.4	72.4	275	258.9	92.6
36	33.9	12.1	96	90.4	32.3	156	146.9	52.5	216	203.4	72.8	276	259.9	93.0
37	34.8	12.5	97	91.3	32.7	157	147.8	52.9	217	204.3	73.1	277	260.8	93.3
38	35.8	12.8	98	92.3	33.0	158	148.8	53.2	218	205.3	73.4	278	261.7	93.7
39	36.7	13.1	99	93.2	33.3	159	149.7	53.6	219	206.2	73.8	279	262.7	94.0
40	37.7	13.5	100	94.2	33.7	160	150.6	53.9	220	207.1	74.1	280	263.6	94.3
41	38.6	13.8	101	95.1	34.0	161	151.6	54.2	221	208.1	74.4	281	264.6	94.7
42	39.5	14.1	102	96.0	34.4	162	152.5	54.6	222	209.0	74.8	282	265.5	95.0
43	40.5	14.5	103	97.0	34.7	163	153.5	54.9	223	210.0	75.1	283	266.5	95.3
44	41.4	14.8	104	97.9	35.0	164	154.4	55.2	224	210.9	75.5	284	267.4	95.7
45	42.4	15.2	105	98.9	35.4	165	155.3	55.6	225	211.8	75.8	285	268.3	96.0
46	43.3	15.5	106	99.8	35.7	166	156.3	55.9	226	212.8	76.1	286	269.3	96.3
47	44.3	15.8	107	100.7	36.0	167	157.2	56.3	227	213.7	76.5	287	270.2	96.7
48	45.2	16.2	108	101.7	36.4	168	158.2	56.6	228	214.7	76.8	288	271.2	97.0
49	46.1	16.5	109	102.6	36.7	169	159.1	56.9	229	215.6	77.1	289	272.1	97.4
50	47.1	16.8	110	103.6	37.1	170	160.1	57.3	230	216.5	77.5	290	273.0	97.7
51	48.0	17.2	111	104.5	37.4	171	161.0	57.6	231	217.5	77.8	291	274.0	98.0
52	49.0	17.5	112	105.4	37.7	172	161.9	57.9	232	218.4	78.2	292	274.9	98.4
53	49.9	17.9	113	106.4	38.1	173	162.9	58.3	233	219.4	78.5	293	275.9	98.7
54	50.8	18.2	114	107.3	38.4	174	163.8	58.6	234	220.3	78.8	294	276.8	99.0
55	51.8	18.5	115	108.3	38.7	175	164.8	59.0	235	221.3	79.2	295	277.7	99.4
56	52.7	18.9	116	109.2	39.1	176	165.7	59.3	236	222.2	79.5	296	278.7	99.7
57	53.7	19.2	117	110.2	39.4	177	166.6	59.6	237	223.1	79.8	297	279.6	100.1
58	54.6	19.5	118	111.1	39.7	178	167.6	60.0	238	224.1	80.2	298	280.6	100.4
59	55.5	19.9	119	112.0	40.1	179	168.5	60.3	239	225.0	80.5	299	281.5	100.7
60	56.5	20.2	120	113.0	40.4	180	169.5	60.6	240	226.0	80.8	300	282.5	101.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 6 ¼ Points.

TABLE I.

Difference of Latitude and Departure for 2 Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	56.4	23.3	121	111.8	46.3	181	167.2	69.3	241	222.7	92.2
2	01.8	00.8	62	57.3	23.7	122	112.7	46.7	182	168.2	69.7	242	223.6	92.6
3	02.8	01.1	63	58.2	24.1	123	113.6	47.1	183	169.1	70.0	243	224.5	93.0
4	03.7	01.5	64	59.1	24.5	124	114.6	47.5	184	170.0	70.4	244	225.4	93.4
5	04.6	01.9	65	60.1	24.9	125	115.5	47.8	185	170.9	70.8	245	226.4	93.8
6	05.5	02.3	66	61.0	25.3	126	116.4	48.2	186	171.8	71.2	246	227.3	94.1
7	06.5	02.7	67	61.9	25.6	127	117.3	48.6	187	172.8	71.6	247	228.2	94.5
8	07.4	03.1	68	62.8	26.0	128	118.3	49.0	188	173.7	71.9	248	229.1	94.9
9	08.3	03.4	69	63.8	26.4	129	119.2	49.4	189	174.6	72.3	249	230.1	95.3
10	09.2	03.8	70	64.7	26.8	130	120.1	49.8	190	175.5	72.7	250	231.0	95.7
11	10.2	04.2	71	65.6	27.2	131	121.0	50.1	191	176.5	73.1	251	231.9	96.1
12	11.1	04.6	72	66.5	27.6	132	122.0	50.5	192	177.4	73.5	252	232.8	96.4
13	12.0	05.0	73	67.4	27.9	133	122.9	50.9	193	178.3	73.9	253	233.7	96.8
14	12.9	05.4	74	68.4	28.3	134	123.8	51.3	194	179.2	74.2	254	234.7	97.2
15	13.9	05.7	75	69.3	28.7	135	124.7	51.7	195	180.2	74.6	255	235.6	97.6
16	14.8	06.1	76	70.2	29.1	136	125.7	52.0	196	181.1	75.0	256	236.5	98.0
17	15.7	06.5	77	71.1	29.5	137	126.6	52.4	197	182.0	75.4	257	237.4	98.4
18	16.6	06.9	78	72.1	29.9	138	127.5	52.8	198	182.9	75.8	258	238.4	98.7
19	17.6	07.3	79	73.0	30.2	139	128.4	53.2	199	183.9	76.2	259	239.3	99.1
20	18.5	07.7	80	73.9	30.6	140	129.3	53.6	200	184.8	76.5	260	240.2	99.5
21	19.4	08.0	81	74.8	31.0	141	130.3	54.0	201	185.7	76.9	261	241.1	99.9
22	20.3	08.4	82	75.8	31.4	142	131.2	54.3	202	186.6	77.3	262	242.1	100.3
23	21.3	08.8	83	76.7	31.8	143	132.1	54.7	203	187.6	77.7	263	243.0	100.6
24	22.2	09.2	84	77.6	32.1	144	133.0	55.1	204	188.5	78.1	264	243.9	101.0
25	23.1	09.6	85	78.5	32.5	145	134.0	55.5	205	189.4	78.5	265	244.8	101.4
26	24.0	10.0	86	79.5	32.9	146	134.9	55.9	206	190.3	78.8	266	245.8	101.8
27	24.9	10.3	87	80.4	33.3	147	135.8	56.3	207	191.2	79.2	267	246.7	102.2
28	25.9	10.7	88	81.3	33.7	148	136.7	56.6	208	192.2	79.6	268	247.6	102.6
29	26.8	11.1	89	82.2	34.1	149	137.7	57.0	209	193.1	80.0	269	248.5	102.9
30	27.7	11.5	90	83.2	34.4	150	138.6	57.4	210	194.0	80.4	270	249.5	103.3
31	28.6	11.9	91	84.1	34.8	151	139.5	57.8	211	194.9	80.8	271	250.4	103.7
32	29.6	12.2	92	85.0	35.2	152	140.4	58.2	212	195.9	81.1	272	251.3	104.1
33	30.5	12.6	93	85.9	35.6	153	141.4	58.6	213	196.8	81.5	273	252.2	104.5
34	31.4	13.0	94	86.8	36.0	154	142.3	58.9	214	197.7	81.9	274	253.1	104.9
35	32.3	13.4	95	87.8	36.4	155	143.2	59.3	215	198.6	82.3	275	254.1	105.2
36	33.3	13.8	96	88.7	36.7	156	144.1	59.7	216	199.6	82.7	276	255.0	105.6
37	34.2	14.2	97	89.6	37.1	157	145.1	60.1	217	200.5	83.0	277	255.9	106.0
38	35.1	14.5	98	90.5	37.5	158	146.0	60.5	218	201.4	83.4	278	256.8	106.4
39	36.0	14.9	99	91.5	37.9	159	146.9	60.9	219	202.3	83.8	279	257.8	106.8
40	37.0	15.3	100	92.4	38.3	160	147.8	61.2	220	203.3	84.2	280	258.7	107.2
41	37.9	15.7	101	93.3	38.7	161	148.7	61.6	221	204.2	84.6	281	259.6	107.5
42	38.8	16.1	102	94.2	39.0	162	149.7	62.0	222	205.1	85.0	282	260.5	107.9
43	39.7	16.5	103	95.2	39.4	163	150.6	62.4	223	206.0	85.3	283	261.5	108.3
44	40.6	16.8	104	96.1	39.8	164	151.5	62.8	224	207.0	85.7	284	262.4	108.7
45	41.6	17.2	105	97.0	40.2	165	152.4	63.1	225	207.9	86.1	285	263.3	109.1
46	42.5	17.6	106	97.9	40.6	166	153.4	63.5	226	208.8	86.5	286	264.2	109.5
47	43.4	18.0	107	98.9	41.0	167	154.3	63.9	227	209.7	86.9	287	265.2	109.8
48	44.4	18.4	108	99.8	41.3	168	155.2	64.3	228	210.6	87.3	288	266.1	110.2
49	45.3	18.8	109	100.7	41.7	169	156.1	64.7	229	211.6	87.6	289	267.0	110.6
50	46.2	19.1	110	101.6	42.1	170	157.1	65.1	230	212.5	88.0	290	267.9	111.0
51	47.1	19.5	111	102.6	42.5	171	158.0	65.4	231	213.4	88.4	291	268.9	111.4
52	48.0	19.9	112	103.5	42.9	172	158.9	65.8	232	214.3	88.8	292	269.8	111.7
53	49.0	20.3	113	104.4	43.2	173	159.8	66.2	233	215.3	89.2	293	270.7	112.1
54	49.9	20.7	114	105.3	43.6	174	160.8	66.6	234	216.2	89.6	294	271.6	112.5
55	50.8	21.0	115	106.3	44.0	175	161.7	67.0	235	217.1	89.9	295	272.5	112.9
56	51.7	21.4	116	107.2	44.4	176	162.6	67.4	236	218.0	90.3	296	273.5	113.3
57	52.7	21.8	117	108.1	44.8	177	163.5	67.7	237	219.0	90.7	297	274.4	113.7
58	53.6	22.2	118	109.0	45.2	178	164.5	68.1	238	219.9	91.1	298	275.3	114.0
59	54.5	22.6	119	109.9	45.5	179	165.4	68.5	239	220.8	91.5	299	276.2	114.4
60	55.4	23.0	120	110.9	45.9	180	166.3	68.9	240	221.7	91.8	300	277.2	114.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 6 Points.

TABLE 1.

Difference of Latitude and Departure for 2 ¼ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	55.1	26.1	121	109.4	51.7	181	163.6	77.4	241	217.9	103.0
2	01.8	00.9	62	56.0	26.5	122	110.3	52.2	182	164.5	77.8	242	218.8	103.5
3	02.7	01.3	63	57.0	26.9	123	111.2	52.6	183	165.4	78.3	243	219.7	103.9
4	03.6	01.7	64	57.9	27.4	124	112.1	53.0	184	166.3	78.7	244	220.6	104.3
5	04.5	02.1	65	58.8	27.8	125	113.0	53.5	185	167.2	79.1	245	221.5	104.8
6	05.4	02.6	66	59.7	28.2	126	113.9	53.9	186	168.1	79.5	246	222.4	105.2
7	06.3	03.0	67	60.6	28.6	127	114.8	54.3	187	169.0	80.0	247	223.3	105.6
8	07.2	03.4	68	61.5	29.1	128	115.7	54.7	188	169.9	80.4	248	224.2	106.0
9	08.1	03.8	69	62.4	29.5	129	116.6	55.2	189	170.9	80.8	249	225.1	106.5
10	09.0	04.3	70	63.3	29.9	130	117.5	55.6	190	171.8	81.2	250	226.0	106.9
11	09.9	04.7	71	64.2	30.4	131	118.4	56.0	191	172.7	81.7	251	226.9	107.3
12	10.8	05.1	72	65.1	30.8	132	119.3	56.4	192	173.6	82.1	252	227.8	107.8
13	11.8	05.6	73	66.0	31.2	133	120.2	56.9	193	174.5	82.5	253	228.7	108.2
14	12.7	06.0	74	66.9	31.6	134	121.1	57.3	194	175.4	83.0	254	229.6	108.6
15	13.6	06.4	75	67.8	32.1	135	122.0	57.7	195	176.3	83.4	255	230.5	109.0
16	14.5	06.8	76	68.7	32.5	136	122.9	58.2	196	177.2	83.8	256	231.4	109.5
17	15.4	07.3	77	69.6	32.9	137	123.8	58.6	197	178.1	84.2	257	232.3	109.9
18	16.3	07.7	78	70.5	33.4	138	124.7	59.0	198	179.0	84.7	258	233.2	110.3
19	17.2	08.1	79	71.4	33.8	139	125.7	59.4	199	179.9	85.1	259	234.1	110.7
20	18.1	08.6	80	72.3	34.2	140	126.6	59.9	200	180.8	85.5	260	235.0	111.2
21	19.0	09.0	81	73.2	34.6	141	127.5	60.3	201	181.7	85.9	261	235.9	111.6
22	19.9	09.4	82	74.1	35.1	142	128.4	60.7	202	182.6	86.4	262	236.8	112.0
23	20.8	09.8	83	75.0	35.5	143	129.3	61.2	203	183.5	86.8	263	237.7	112.5
24	21.7	10.3	84	75.9	35.9	144	130.2	61.6	204	184.4	87.2	264	238.7	112.9
25	22.6	10.7	85	76.8	36.3	145	131.1	62.0	205	185.3	87.7	265	239.6	113.3
26	23.5	11.1	86	77.7	36.8	146	132.0	62.4	206	186.2	88.1	266	240.5	113.7
27	24.4	11.5	87	78.6	37.2	147	132.9	62.9	207	187.1	88.5	267	241.4	114.2
28	25.3	12.0	88	79.6	37.6	148	133.8	63.3	208	188.0	88.9	268	242.3	114.6
29	26.2	12.4	89	80.5	38.1	149	134.7	63.7	209	188.9	89.4	269	243.2	115.0
30	27.1	12.8	90	81.4	38.5	150	135.6	64.1	210	189.8	89.8	270	244.1	115.4
31	28.0	13.3	91	82.3	38.9	151	136.5	64.6	211	190.7	90.2	271	245.0	115.9
32	28.9	13.7	92	83.2	39.3	152	137.4	65.0	212	191.6	90.6	272	245.9	116.3
33	29.8	14.1	93	84.1	39.8	153	138.3	65.4	213	192.6	91.1	273	246.8	116.7
34	30.7	14.5	94	85.0	40.2	154	139.2	65.9	214	193.5	91.5	274	247.7	117.2
35	31.6	15.0	95	85.9	40.6	155	140.1	66.3	215	194.4	91.9	275	248.6	117.6
36	32.5	15.4	96	86.8	41.1	156	141.0	66.7	216	195.3	92.4	276	249.5	118.0
37	33.4	15.8	97	87.7	41.5	157	141.9	67.1	217	196.2	92.8	277	250.4	118.4
38	34.4	16.2	98	88.6	41.9	158	142.8	67.6	218	197.1	93.2	278	251.3	118.9
39	35.3	16.7	99	89.5	42.3	159	143.7	68.0	219	198.0	93.6	279	252.2	119.3
40	36.2	17.1	100	90.4	42.8	160	144.6	68.4	220	198.9	94.1	280	253.1	119.7
41	37.1	17.5	101	91.3	43.2	161	145.5	68.8	221	199.8	94.5	281	254.0	120.2
42	38.0	18.0	102	92.2	43.6	162	146.4	69.3	222	200.7	94.9	282	254.9	120.6
43	38.9	18.4	103	93.1	44.0	163	147.3	69.7	223	201.6	95.4	283	255.8	121.0
44	39.8	18.8	104	94.0	44.5	164	148.3	70.1	224	202.5	95.8	284	256.7	121.4
45	40.7	19.2	105	94.9	44.9	165	149.2	70.6	225	203.4	96.2	285	257.6	121.9
46	41.6	19.7	106	95.8	45.3	166	150.1	71.0	226	204.3	96.6	286	258.5	122.3
47	42.5	20.1	107	96.7	45.8	167	151.0	71.4	227	205.2	97.1	287	259.4	122.7
48	43.4	20.5	108	97.6	46.2	168	151.9	71.8	228	206.1	97.5	288	260.3	123.1
49	44.3	21.0	109	98.5	46.6	169	152.8	72.3	229	207.0	97.9	289	261.3	123.6
50	45.2	21.4	110	99.4	47.0	170	153.7	72.7	230	207.9	98.3	290	262.2	124.0
51	46.1	21.8	111	100.3	47.5	171	154.6	73.1	231	208.8	98.8	291	263.1	124.4
52	47.0	22.2	112	101.2	47.9	172	155.5	73.6	232	209.7	99.2	292	264.0	124.9
53	47.9	22.7	113	102.1	48.3	173	156.4	74.0	233	210.6	99.6	293	264.9	125.3
54	48.8	23.1	114	103.1	48.7	174	157.3	74.4	234	211.5	100.1	294	265.8	125.7
55	49.7	23.5	115	104.0	49.2	175	158.2	74.8	235	212.4	100.5	295	266.7	126.1
56	50.6	23.9	116	104.9	49.6	176	159.1	75.3	236	213.3	100.9	296	267.6	126.6
57	51.5	24.4	117	105.8	50.0	177	160.0	75.7	237	214.2	101.3	297	268.5	127.0
58	52.4	24.8	118	106.7	50.5	178	160.9	76.1	238	215.1	101.8	298	269.4	127.4
59	53.3	25.2	119	107.6	50.9	179	161.8	76.5	239	216.1	102.2	299	270.3	127.8
60	54.2	25.7	120	108.5	51.3	180	162.7	77.0	240	217.0	102.6	300	271.2	128.3
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 5 ¾ Points.

TABLE I.

Difference of Latitude and Departure for 2 ½ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	53.8	28.8	121	106.7	57.0	181	159.6	85.3	241	212.5	113.6
2	01.8	00.9	62	54.7	29.2	122	107.6	57.5	182	160.5	85.8	242	213.4	114.1
3	02.6	01.4	63	55.6	29.7	123	108.5	58.0	183	161.4	86.3	243	214.3	114.6
4	03.5	01.9	64	56.4	30.2	124	109.4	58.4	184	162.3	86.7	244	215.2	115.0
5	04.4	02.4	65	57.3	30.6	125	110.2	58.9	185	163.2	87.2	245	216.1	115.5
6	05.3	02.8	66	58.2	31.1	126	111.1	59.4	186	164.0	87.7	246	217.0	116.0
7	06.2	03.3	67	59.1	31.6	127	112.0	59.9	187	164.9	88.1	247	217.8	116.4
8	07.1	03.8	68	60.0	32.1	128	112.9	60.3	188	165.8	88.6	248	218.7	116.9
9	07.9	04.2	69	60.9	32.5	129	113.8	60.8	189	166.7	89.1	249	219.6	117.4
10	08.8	04.7	70	61.7	33.0	130	114.7	61.3	190	167.6	89.6	250	220.5	117.8
11	09.7	05.2	71	62.6	33.5	131	115.5	61.7	191	168.5	90.0	251	221.4	118.3
12	10.6	05.7	72	63.5	33.9	132	116.4	62.2	192	169.3	90.5	252	222.2	118.8
13	11.5	06.1	73	64.4	34.4	133	117.3	62.7	193	170.2	91.0	253	223.1	119.3
14	12.3	06.6	74	65.3	34.9	134	118.2	63.2	194	171.1	91.4	254	224.0	119.7
15	13.2	07.1	75	66.1	35.4	135	119.1	63.6	195	172.0	91.9	255	224.9	120.2
16	14.1	07.5	76	67.0	35.8	136	119.9	64.1	196	172.9	92.4	256	225.8	120.7
17	15.0	08.0	77	67.9	36.3	137	120.8	64.6	197	173.7	92.9	257	226.7	121.1
18	15.9	08.5	78	68.8	36.8	138	121.7	65.0	198	174.6	93.3	258	227.5	121.6
19	16.8	09.0	79	69.7	37.2	139	122.6	65.5	199	175.5	93.8	259	228.4	122.1
20	17.6	09.4	80	70.6	37.7	140	123.5	66.0	200	176.4	94.3	260	229.3	122.6
21	18.5	09.9	81	71.4	38.2	141	124.4	66.5	201	177.3	94.7	261	230.2	123.0
22	19.4	10.4	82	72.3	38.6	142	125.2	66.9	202	178.2	95.2	262	231.1	123.5
23	20.3	10.8	83	73.2	39.1	143	126.1	67.4	203	179.0	95.7	263	231.9	124.0
24	21.2	11.3	84	74.1	39.6	144	127.0	67.9	204	179.9	96.2	264	232.8	124.4
25	22.1	11.8	85	75.0	40.1	145	127.9	68.3	205	180.8	96.6	265	233.7	124.9
26	22.9	12.3	86	75.9	40.5	146	128.8	68.8	206	181.7	97.1	266	234.6	125.4
27	23.8	12.7	87	76.7	41.0	147	129.6	69.3	207	182.6	97.6	267	235.5	125.9
28	24.7	13.2	88	77.6	41.5	148	130.5	69.8	208	183.4	98.0	268	236.4	126.3
29	25.6	13.7	89	78.5	41.9	149	131.4	70.2	209	184.3	98.5	269	237.2	126.8
30	26.5	14.1	90	79.4	42.4	150	132.3	70.7	210	185.2	99.0	270	238.1	127.3
31	27.3	14.6	91	80.3	42.9	151	133.2	71.2	211	186.1	99.5	271	239.0	127.7
32	28.2	15.1	92	81.1	43.4	152	134.1	71.6	212	187.0	99.9	272	239.9	128.2
33	29.1	15.6	93	82.0	43.8	153	134.9	72.1	213	187.8	100.4	273	240.8	128.7
34	30.0	16.0	94	82.9	44.3	154	135.8	72.6	214	188.7	100.9	274	241.7	129.2
35	30.9	16.5	95	83.8	44.8	155	136.7	73.1	215	189.6	101.3	275	242.5	129.6
36	31.8	17.0	96	84.7	45.2	156	137.6	73.5	216	190.5	101.8	276	243.4	130.1
37	32.6	17.4	97	85.6	45.7	157	138.5	74.0	217	191.4	102.3	277	244.3	130.6
38	33.5	17.9	98	86.4	46.2	158	139.3	74.5	218	192.3	102.8	278	245.2	131.0
39	34.4	18.4	99	87.3	46.7	159	140.2	74.9	219	193.1	103.2	279	246.1	131.5
40	35.3	18.9	100	88.2	47.1	160	141.1	75.4	220	194.0	103.7	280	246.9	132.0
41	36.2	19.3	101	89.1	47.6	161	142.0	75.9	221	194.9	104.2	281	247.8	132.5
42	37.0	19.8	102	90.0	48.1	162	142.9	76.4	222	195.8	104.6	282	248.7	132.9
43	37.9	20.3	103	90.8	48.5	163	143.8	76.8	223	196.7	105.1	283	249.6	133.4
44	38.8	20.7	104	91.7	49.0	164	144.6	77.3	224	197.6	105.6	284	250.5	133.9
45	39.7	21.2	105	92.6	49.5	165	145.5	77.8	225	198.4	106.1	285	251.4	134.3
46	40.6	21.7	106	93.5	50.0	166	146.4	78.2	226	199.3	106.5	286	252.2	134.8
47	41.5	22.2	107	94.4	50.4	167	147.3	78.7	227	200.2	107.0	287	253.1	135.3
48	42.3	22.6	108	95.3	50.9	168	148.2	79.2	228	201.1	107.5	288	254.0	135.8
49	43.2	23.1	109	96.1	51.4	169	149.0	79.7	229	202.0	107.9	289	254.9	136.2
50	44.1	23.6	110	97.0	51.8	170	149.9	80.1	230	202.8	108.4	290	255.8	136.7
51	45.0	24.0	111	97.9	52.3	171	150.8	80.6	231	203.7	108.9	291	256.6	137.2
52	45.9	24.5	112	98.8	52.8	172	151.7	81.1	232	204.6	109.4	292	257.5	137.6
53	46.7	25.0	113	99.7	53.3	173	152.6	81.5	233	205.5	109.8	293	258.4	138.1
54	47.6	25.5	114	100.5	53.7	174	153.5	82.0	234	206.4	110.3	294	259.3	138.6
55	48.5	25.9	115	101.4	54.2	175	154.3	82.5	235	207.3	110.8	295	260.2	139.1
56	49.4	26.4	116	102.3	54.7	176	155.2	83.0	236	208.1	111.2	296	261.1	139.5
57	50.3	26.9	117	103.2	55.1	177	156.1	83.4	237	209.0	111.7	297	261.9	140.0
58	51.2	27.3	118	104.1	55.6	178	157.0	83.9	238	209.9	112.2	298	262.8	140.5
59	52.0	27.8	119	105.0	56.1	179	157.9	84.4	239	210.8	112.7	299	263.7	140.9
60	52.9	28.3	120	105.8	56.6	180	158.8	84.8	240	211.7	113.1	300	264.6	141.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 5 ½ Points.

TABLE I.

Difference of Latitude and Departure for 2 ¾ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep
1	00.9	00.5	61	52.3	31.4	121	103.8	62.2	181	155.3	93.0	241	206.7	123.9
2	01.7	01.0	62	53.2	31.9	122	104.6	62.7	182	156.1	93.6	242	207.6	124.4
3	02.6	01.5	63	54.0	32.4	123	105.5	63.2	183	157.0	94.1	243	208.4	124.9
4	03.4	02.1	64	54.9	32.9	124	106.4	63.7	184	157.8	94.6	244	209.3	125.4
5	04.3	02.6	65	55.8	33.4	125	107.2	64.3	185	158.7	95.1	245	210.1	125.9
6	05.1	03.1	66	56.6	33.9	126	108.1	64.8	186	159.5	95.6	246	211.0	126.5
7	06.0	03.6	67	57.5	34.4	127	108.9	65.3	187	160.4	96.1	247	211.9	127.0
8	06.9	04.1	68	58.3	35.0	128	109.8	65.8	188	161.2	96.6	248	212.7	127.5
9	07.7	04.6	69	59.2	35.5	129	110.6	66.3	189	162.1	97.2	249	213.6	128.0
10	08.6	05.1	70	60.0	36.0	130	111.5	66.8	190	163.0	97.7	250	214.4	128.5
11	09.4	05.7	71	60.9	36.5	131	112.4	67.3	191	163.8	98.2	251	215.3	129.0
12	10.3	06.2	72	61.8	37.0	132	113.2	67.9	192	164.7	98.7	252	216.1	129.5
13	11.2	06.7	73	62.6	37.5	133	114.1	68.4	193	165.5	99.2	253	217.0	130.1
14	12.0	07.2	74	63.5	38.0	134	114.9	68.9	194	166.4	99.7	254	217.9	130.6
15	12.9	07.7	75	64.3	38.6	135	115.8	69.4	195	167.3	100.2	255	218.7	131.1
16	13.7	08.2	76	65.2	39.1	136	116.6	69.9	196	168.1	100.8	256	219.6	131.6
17	14.6	08.7	77	66.0	39.6	137	117.5	70.4	197	169.0	101.3	257	220.4	132.1
18	15.4	09.3	78	66.9	40.1	138	118.4	70.9	198	169.8	101.8	258	221.3	132.6
19	16.3	09.8	79	67.8	40.6	139	119.2	71.5	199	170.7	102.3	259	222.1	133.1
20	17.2	10.3	80	68.6	41.1	140	120.1	72.0	200	171.5	102.8	260	223.0	133.7
21	18.0	10.8	81	69.5	41.6	141	120.9	72.5	201	172.4	103.3	261	223.9	134.2
22	18.9	11.3	82	70.3	42.2	142	121.8	73.0	202	173.3	103.8	262	224.7	134.7
23	19.7	11.8	83	71.2	42.7	143	122.7	73.5	203	174.1	104.4	263	225.6	135.2
24	20.6	12.3	84	72.0	43.2	144	123.5	74.0	204	175.0	104.9	264	226.4	135.7
25	21.4	12.9	85	72.9	43.7	145	124.4	74.5	205	175.8	105.4	265	227.3	136.2
26	22.3	13.4	86	73.8	44.2	146	125.2	75.1	206	176.7	105.9	266	228.2	136.7
27	23.2	13.9	87	74.6	44.7	147	126.1	75.6	207	177.5	106.4	267	229.0	137.3
28	24.0	14.4	88	75.5	45.2	148	126.9	76.1	208	178.4	106.9	268	229.9	137.8
29	24.9	14.9	89	76.3	45.7	149	127.8	76.6	209	179.2	107.4	269	230.7	138.3
30	25.7	15.4	90	77.2	46.3	150	128.7	77.1	210	180.1	108.0	270	231.6	138.8
31	26.6	15.9	91	78.1	46.8	151	129.5	77.6	211	181.0	108.5	271	232.4	139.3
32	27.4	16.4	92	78.9	47.3	152	130.4	78.1	212	181.8	109.0	272	233.3	139.8
33	28.3	17.0	93	79.8	47.8	153	131.2	78.7	213	182.7	109.5	273	234.2	140.3
34	29.2	17.5	94	80.6	48.3	154	132.1	79.2	214	183.5	110.0	274	235.0	140.9
35	30.0	18.0	95	81.5	48.8	155	132.9	79.7	215	184.4	110.5	275	235.9	141.4
36	30.9	18.5	96	82.3	49.3	156	133.8	80.2	216	185.3	111.0	276	236.7	141.9
37	31.7	19.0	97	83.2	49.9	157	134.7	80.7	217	186.1	111.6	277	237.6	142.4
38	32.6	19.5	98	84.1	50.4	158	135.5	81.2	218	187.0	112.1	278	238.4	142.9
39	33.5	20.0	99	84.9	50.9	159	136.4	81.7	219	187.8	112.6	279	239.3	143.4
40	34.3	20.6	100	85.8	51.5	160	137.2	82.3	220	188.7	113.1	280	240.2	143.9
41	35.2	21.1	101	86.6	51.9	161	138.1	82.8	221	189.6	113.6	281	241.0	144.5
42	36.0	21.6	102	87.5	52.4	162	138.9	83.3	222	190.4	114.1	282	241.9	145.0
43	36.9	22.1	103	88.3	52.9	163	139.8	83.8	223	191.3	114.6	283	242.7	145.5
44	37.7	22.6	104	89.2	53.5	164	140.7	84.3	224	192.1	115.2	284	243.6	146.0
45	38.6	23.1	105	90.1	54.0	165	141.5	84.8	225	193.0	115.7	285	244.4	146.5
46	39.5	23.6	106	90.9	54.5	166	142.4	85.3	226	193.8	116.2	286	245.3	147.0
47	40.3	24.2	107	91.8	55.0	167	143.2	85.8	227	194.7	116.7	287	246.2	147.5
48	41.2	24.7	108	92.6	55.5	168	144.1	86.4	228	195.6	117.2	288	247.0	148.1
49	42.0	25.2	109	93.5	56.0	169	145.0	86.9	229	196.4	117.7	289	247.9	148.6
50	42.9	25.7	110	94.3	56.5	170	145.8	87.4	230	197.3	118.2	290	248.7	149.1
51	43.7	26.2	111	95.2	57.1	171	146.7	87.9	231	198.1	118.8	291	249.6	149.6
52	44.6	26.7	112	96.1	57.6	172	147.5	88.4	232	199.0	119.3	292	250.5	150.1
53	45.5	27.2	113	96.9	58.1	173	148.4	88.9	233	199.8	119.8	293	251.3	150.6
54	46.3	27.8	114	97.8	58.6	174	149.2	89.4	234	200.7	120.3	294	252.2	151.1
55	47.2	28.3	115	98.6	59.1	175	150.1	90.0	235	201.6	120.8	295	253.0	151.7
56	48.0	28.8	116	99.5	59.6	176	151.0	90.5	236	202.4	121.3	296	253.9	152.2
57	48.9	29.3	117	100.4	60.1	177	151.8	91.0	237	203.3	121.8	297	254.7	152.7
58	49.7	29.8	118	101.2	60.7	178	152.7	91.5	238	204.1	122.4	298	255.6	153.2
59	50.6	30.3	119	102.1	61.2	179	153.5	92.0	239	205.0	122.9	299	256.5	153.7
60	51.5	30.8	120	102.9	61.7	180	154.4	92.5	240	205.9	123.4	300	257.3	154.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 5 ¼ Points.

TABLE I

Difference of Latitude and Departure for 3 Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	50.7	33.9	121	100.6	67.2	181	150.5	100.6	241	200.4	133.9
2	01.7	01.1	62	51.5	34.4	122	101.4	67.8	182	151.3	101.1	242	201.2	134.4
3	02.5	01.7	63	52.4	35.0	123	102.3	68.3	183	152.2	101.7	243	202.0	135.0
4	03.3	02.2	64	53.2	35.6	124	103.1	68.9	184	153.0	102.2	244	202.9	135.6
5	04.2	02.8	65	54.0	36.1	125	103.9	69.4	185	153.8	102.8	245	203.7	136.1
6	05.0	03.3	66	54.9	36.7	126	104.8	70.0	186	154.6	103.3	246	204.5	136.7
7	05.8	03.9	67	55 7	37.2	127	105.6	70.6	187	155.5	103.9	247	205.4	137.2
8	06.7	04.4	68	56.5	37.8	128	106.4	71.1	188	156.3	104.4	248	206.2	137.8
9	07.5	05.0	69	57.4	38.3	129	107.3	71.7	189	157.1	105.0	249	207.0	138.3
10	08.3	05.6	70	58.2	38.9	130	108.1	72.2	190	158.0	105.6	250	207.9	138.9
11	09.1	06.1	71	59.0	39.4	131	108.9	72.8	191	158.8	106.1	251	208.7	139.4
12	10.0	06.7	72	59.9	40.0	132	109.7	73.3	192	159.6	106.7	252	209.5	140.0
13	10.8	07.2	73	60.7	40.6	133	110.6	73.9	193	160.5	107.2	253	210.4	140.6
14	11.6	07.8	74	61.5	41.1	134	111.4	74.4	194	161.3	107.8	254	211.2	141.1
15	12.5	08.3	75	62.4	41.7	135	112.2	75.0	195	162.1	108.3	255	212.0	141.7
16	13.3	08.9	76	63.2	42.2	136	113.1	75.6	196	163.0	108.9	256	212.9	142.2
17	14.1	09.4	77	64.0	42.8	137	113.9	76.1	197	163.8	109.4	257	213.7	142.8
18	15.0	10.0	78	64.8	43.3	138	114.7	76.7	198	164.6	110.0	258	214.5	143.3
19	15.8	10.6	79	65.7	43.9	139	115.6	77.2	199	165.5	110.6	259	215.3	143.9
20	16.6	11.1	80	66.5	44.4	140	116.4	77.8	200	166.3	111.1	260	216.2	144.4
21	17.5	11.7	81	67.3	45.0	141	117.2	78.3	201	167.1	111.7	261	217.0	145.0
22	18.3	12.2	82	68.2	45.6	142	118.1	78.9	202	168.0	112.2	262	217.8	145.6
23	19.1	12.8	83	69.0	46.1	143	118.9	79.4	203	168.8	112.8	263	218.7	146.1
24	20.0	13.3	84	69.8	46.7	144	119.7	80.0	204	169.6	113.3	264	219.5	146.7
25	20.8	13.9	85	70.7	47.2	145	120.6	80.6	205	170.4	113.9	265	220.3	147.2
26	21.6	14.4	86	71.5	47.8	146	121.4	81.1	206	171.3	114.4	266	221.2	147.8
27	22.4	15.0	87	72.3	48.3	147	122.2	81.7	207	172.1	115.0	267	222.0	148.3
28	23.3	15.6	88	73.2	48.9	148	123.1	82.2	208	172.9	115.6	268	222.8	148.9
29	24.1	16.1	89	74.0	49.4	149	123.9	82.8	209	173.8	116.1	269	223.7	149.4
30	24.9	16.7	90	74.8	50.0	150	124.7	83.3	210	174.6	116.7	270	224.5	150.0
31	25.8	17.2	91	75.7	50.6	151	125.5	83.9	211	175.4	117.2	271	225.3	150.6
32	26.6	17.8	92	76.5	51.1	152	126.4	84.4	212	176.3	117.8	272	226.2	151.1
33	27.4	18.3	93	77.3	51.7	153	127.2	85.0	213	177.1	118.3	273	227.0	151.7
34	28.3	18.9	94	78.2	52.2	154	128.0	85.6	214	177.9	118.9	274	227.8	152.2
35	29.1	19.4	95	79.0	52.8	155	128.9	86.1	215	178.8	119.4	275	228.6	152.8
36	29.9	20.0	96	79.8	53.3	156	129.7	86.7	216	179.6	120.0	276	229.5	153.3
37	30.8	20.6	97	80.6	53.9	157	130.5	87.2	217	180.4	120.6	277	230.3	153.9
38	31.6	21.1	98	81.5	54.4	158	131.4	87.8	218	181.3	121.1	278	231.1	154.4
39	32.4	21.7	99	82.3	55.0	159	132.2	88.3	219	182.1	121.7	279	232.0	155.0
40	33.3	22.2	100	83.1	55.6	160	133.0	88.9	220	182.9	122.2	280	232.8	155.6
41	34.1	22.8	101	84.0	56.1	161	133.9	89.4	221	183.7	122.8	281	233.6	156.1
42	34.9	23.3	102	84.8	56.7	162	134.7	90.0	222	184.6	123.3	282	234.5	156.7
43	35.8	23.9	103	85.6	57.2	163	135.5	90.6	223	185.4	123.9	283	235.3	157.2
44	36.6	24.4	104	86.5	57.8	164	136.4	91.1	224	186.2	124.4	284	236.1	157.8
45	37.4	25.0	105	87.3	58.3	165	137.2	91.7	225	187.1	125.0	285	237.0	158.3
46	38.2	25.6	106	88.1	58.9	166	138.0	92.2	226	187.9	125.6	286	237.8	158.9
47	39.1	26.1	107	89.0	59.4	167	138.9	92.8	227	188.7	126.1	287	238.6	159.4
48	39.9	26.7	108	89.8	60.0	168	139.7	93.3	228	189.6	126.7	288	239.5	160.0
49	40.7	27.2	109	90.6	60.6	169	140.5	93.9	229	190.4	127.2	289	240.3	160.6
50	41.6	27.8	110	91.5	61.1	170	141.3	94.4	230	191.2	127.8	290	241.1	161.1
51	42.4	28.3	111	92.3	61.7	171	142.2	95.0	231	192.1	128.3	291	242.0	161.7
52	43.2	28.9	112	93.1	62.2	172	143.0	95.6	232	192.9	128.9	292	242.8	162.2
53	44.1	29.4	113	94.0	62.8	173	143.8	96.1	233	193.7	129.4	293	243.6	162.8
54	44.9	30.0	114	94.8	63.3	174	144.7	96.7	234	194.6	130.0	294	244.4	163.3
55	45.7	30.6	115	95.6	63.9	175	145.5	97.2	235	195.4	130.6	295	245.3	163.9
56	46.6	31.1	116	96.4	64.4	176	146.3	97.8	236	196.2	131.1	296	246.1	164.4
57	47.4	31.7	117	97.3	65.0	177	147.2	98.3	237	197.1	131.7	297	246.9	165.0
58	48.2	32.2	118	98.1	65.6	178	148.0	98.9	238	197.9	132.2	298	247.8	165.6
59	49.1	32.8	119	98.9	66.1	179	148.8	99.4	239	198.7	132 8	299	248.6	166.1
60	49.9	33.3	120	99.8	66.7	180	149.7	100.0	240	199.5	133.3	300	249.4	166.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 5 Points.

Lat 42.. 42 Salem Long of Salem 70.. 54
33. 28 Ship. Long of Ship 57.. 06
9.14 13.. 48
60 45
554 65
52
48
633

D Lat Dep
554.. 633 gives 820 miles distance

S E ½ E course in 6 days gives
136 miles per day.

TABLE I.

Difference of Latitude and Departure for 3¼ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	49.0	36.3	121	97.2	72.1	181	145.4	107.8	241	193.6	143.6
2	01.6	01.2	62	49.8	36.9	122	98.0	72.7	182	146.2	108.4	242	194.4	144.2
3	02.4	01.8	63	50.6	37.5	123	98.8	73.3	183	147.0	109.0	243	195.2	144.8
4	03.2	02.4	64	51.4	38.1	124	99.6	73.9	184	147.8	109.6	244	196.0	145.4
5	04.0	03.0	65	52.2	38.7	125	100.4	74.5	185	148.6	110.2	245	196.8	146.0
6	04.8	03.6	66	53.0	39.3	126	101.2	75.1	186	149.4	110.8	246	197.6	146.5
7	05.6	04.2	67	53.8	39.9	127	102.0	75.7	187	150.2	111.4	247	198.4	147.1
8	06.4	04.8	68	54.6	40.5	128	102.8	76.3	188	151.0	112.0	248	199.2	147.7
9	07.2	05.4	69	55.4	41.1	129	103.6	76.9	189	151.8	112.6	249	200.0	148.3
10	08.0	06.0	70	56.2	41.7	130	104.4	77.4	190	152.6	113.2	250	200.8	148.9
11	08.8	06.6	71	57.0	42.3	131	105.2	78.0	191	153.4	113.8	251	201.6	149.5
12	09.6	07.1	72	57.8	42.9	132	106.0	78.6	192	154.2	114.4	252	202.4	150.1
13	10.4	07.7	73	58.6	43.5	133	106.8	79.2	193	155.0	115.0	253	203.2	150.7
14	11.2	08.3	74	59.4	44.1	134	107.6	79.8	194	155.8	115.6	254	204.0	151.3
15	12.0	08.9	75	60.2	44.7	135	108.4	80.4	195	156.6	116.2	255	204.8	151.9
16	12.8	09.5	76	61.0	45.3	136	109.2	81.0	196	157.4	116.8	256	205.6	152.5
17	13.7	10.1	77	61.8	45.9	137	110.0	81.6	197	158.2	117.4	257	206.4	153.1
18	14.5	10.7	78	62.6	46.5	138	110.8	82.2	198	159.0	118.0	258	207.2	153.7
19	15.3	11.3	79	63.4	47.1	139	111.6	82.8	199	159.8	118.5	259	208.0	154.3
20	16.1	11.9	80	64.3	47.7	140	112.4	83.4	200	160.6	119.1	260	208.8	154.9
21	16.9	12.5	81	65.1	48.3	141	113.2	84.0	201	161.4	119.7	261	209.6	155.5
22	17.7	13.1	82	65.9	48.9	142	114.0	84.6	202	162.2	120.3	262	210.4	156.1
23	18.5	13.7	83	66.7	49.4	143	114.9	85.2	203	163.0	120.9	263	211.2	156.7
24	19.3	14.3	84	67.5	50.0	144	115.7	85.8	204	163.9	121.5	264	212.0	157.3
25	20.1	14.9	85	68.3	50.6	145	116.5	86.4	205	164.7	122.1	265	212.8	157.9
26	20.9	15.5	86	69.1	51.2	146	117.3	87.0	206	165.5	122.7	266	213.6	158.5
27	21.7	16.1	87	69.9	51.8	147	118.1	87.6	207	166.3	123.3	267	214.5	159.1
28	22.5	16.7	88	70.7	52.4	148	118.9	88.2	208	167.1	123.9	268	215.3	159.6
29	23.3	17.3	89	71.5	53.0	149	119.7	88.8	209	167.9	124.5	269	216.1	160.2
30	24.1	17.9	90	72.3	53.6	150	120.5	89.4	210	168.7	125.1	270	216.9	160.8
31	24.9	18.5	91	73.1	54.2	151	121.3	90.0	211	169.5	125.7	271	217.7	161.4
32	25.7	19.1	92	73.9	54.8	152	122.1	90.5	212	170.3	126.3	272	218.5	162.0
33	26.5	19.7	93	74.7	55.4	153	122.9	91.1	213	171.1	126.9	273	219.3	162.6
34	27.3	20.3	94	75.5	56.0	154	123.7	91.7	214	171.9	127.5	274	220.1	163.2
35	28.1	20.9	95	76.3	56.6	155	124.5	92.3	215	172.7	128.1	275	220.9	163.8
36	28.9	21.4	96	77.1	57.2	156	125.3	92.9	216	173.5	128.7	276	221.7	164.4
37	29.7	22.0	97	77.9	57.8	157	126.1	93.5	217	174.3	129.3	277	222.5	165.0
38	30.5	22.6	98	78.7	58.4	158	126.9	94.1	218	175.1	129.9	278	223.3	165.6
39	31.3	23.2	99	79.5	59.0	159	127.7	94.7	219	175.9	130.5	279	224.1	166.2
40	32.1	23.8	100	80.3	59.6	160	128.5	95.3	220	176.7	131.1	280	224.9	166.8
41	32.9	24.4	101	81.1	60.2	161	129.3	95.9	221	177.5	131.7	281	225.7	167.4
42	33.7	25.0	102	81.9	60.8	162	130.1	96.5	222	178.3	132.2	282	226.5	168.0
43	34.5	25.6	103	82.7	61.4	163	130.9	97.1	223	179.1	132.8	283	227.3	168.6
44	35.3	26.2	104	83.5	62.0	164	131.7	97.7	224	179.9	133.4	284	228.1	169.2
45	36.1	26.8	105	84.3	62.6	165	132.5	98.3	225	180.7	134.0	285	228.9	169.8
46	36.9	27.4	106	85.1	63.1	166	133.3	98.9	226	181.5	134.6	286	229.7	170.4
47	37.7	28.0	107	85.9	63.7	167	134.1	99.5	227	182.3	135.2	287	230.5	171.0
48	38.6	28.6	108	86.7	64.3	168	134.9	100.1	228	183.1	135.8	288	231.3	171.6
49	39.4	29.2	109	87.5	64.9	169	135.7	100.7	229	183.9	136.4	289	232.1	172.2
50	40.2	29.8	110	88.4	65.5	170	136.5	101.3	230	184.7	137.0	290	232.9	172.8
51	41.0	30.4	111	89.2	66.1	171	137.3	101.9	231	185.5	137.6	291	233.7	173.3
52	41.8	31.0	112	90.0	66.7	172	138.1	102.5	232	186.3	138.2	292	234.5	173.9
53	42.6	31.6	113	90.8	67.3	173	138.9	103.1	233	187.1	138.8	293	235.3	174.5
54	43.4	32.2	114	91.6	67.9	174	139.8	103.7	234	187.9	139.4	294	236.1	175.1
55	44.2	32.8	115	92.4	68.5	175	140.6	104.2	235	188.8	140.0	295	236.9	175.7
56	45.0	33.4	116	93.2	69.1	176	141.4	104.8	236	189.6	140.6	296	237.7	176.3
57	45.8	34.0	117	94.0	69.7	177	142.2	105.4	237	190.4	141.2	297	238.5	176.9
58	46.6	34.6	118	94.8	70.3	178	143.0	106.0	238	191.2	141.8	298	239.4	177.5
59	47.4	35.1	119	95.6	70.9	179	143.8	106.6	239	192.0	142.4	299	240.2	178.1
60	48.2	35.7	120	96.4	71.5	180	144.6	107.2	240	192.8	143.0	300	241.0	178.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 4¾ Points.

TABLE I.

Difference of Latitude and Departure for 3 ½ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	47.1	38.7	121	93.5	76.8	181	139.9	114.8	241	186.3	152.9
2	01.5	01.3	62	47.9	39.3	122	94.3	77.4	182	140.7	115.5	242	187.1	153.5
3	02.3	01.9	63	48.7	40.0	123	95.1	78.0	183	141.5	116.1	243	187.8	154.2
4	03.1	02.5	64	49.5	40.6	124	95.8	78.7	184	142.2	116.7	244	188.6	154.8
5	03.9	03.2	65	50.2	41.2	125	96.6	79.3	185	143.0	117.4	245	189.4	155.4
6	04.6	03.8	66	51.0	41.9	126	97.4	79.9	186	143.8	118.0	246	190.2	156.1
7	05.4	04.4	67	51.8	42.5	127	98.2	80.6	187	144.5	118.6	247	190.9	156.7
8	06.2	05.1	68	52.6	43.1	128	98.9	81.2	188	145.3	119.3	248	191.7	157.3
9	07.0	05.7	69	53.3	43.8	129	99.7	81.8	189	146.1	119.9	249	192.5	158.0
10	07.7	06.3	70	54.1	44.4	130	100.5	82.5	190	146.9	120.5	250	193.2	158.6
11	08.5	07.0	71	54.9	45.0	131	101.3	83.1	191	147.6	121.2	251	194.0	159.2
12	09.3	07.6	72	55.7	45.7	132	102.0	83.7	192	148.4	121.8	252	194.8	159.9
13	10.1	08.2	73	56.4	46.3	133	102.8	84.4	193	149.2	122.4	253	195.6	160.5
14	10.8	08.9	74	57.2	46.9	134	103.6	85.0	194	150.0	123.1	254	196.3	161.1
15	11.6	09.5	75	58.0	47.6	135	104.4	85.6	195	150.7	123.7	255	197.1	161.8
16	12.4	10.1	76	58.7	48.2	136	105.1	86.3	196	151.5	124.3	256	197.9	162.4
17	13.1	10.8	77	59.5	48.8	137	105.9	86.9	197	152.3	125.0	257	198.7	163.0
18	13.9	11.4	78	60.3	49.5	138	106.7	87.5	198	153.1	125.6	258	199.4	163.7
19	14.7	12.0	79	61.1	50.1	139	107.4	88.2	199	153.8	126.2	259	200.2	164.3
20	15.5	12.7	80	61.8	50.7	140	108.2	88.8	200	154.6	126.9	260	201.0	164.9
21	16.2	13.3	81	62.6	51.4	141	109.0	89.4	201	155.4	127.5	261	201.8	165.6
22	17.0	14.0	82	63.4	52.0	142	109.8	90.1	202	156.1	128.1	262	202.5	166.2
23	17.8	14.6	83	64.2	52.7	143	110.5	90.7	203	156.9	128.8	263	203.3	166.8
24	18.5	15.2	84	64.9	53.3	144	111.3	91.3	204	157.7	129.4	264	204.1	167.5
25	19.3	15.9	85	65.7	53.9	145	112.1	92.0	205	158.5	130.0	265	204.8	168.1
26	20.1	16.5	86	66.5	54.6	146	112.9	92.6	206	159.2	130.7	266	205.6	168.7
27	20.9	17.1	87	67.2	55.2	147	113.6	93.3	207	160.0	131.3	267	206.4	169.4
28	21.6	17.8	88	68.0	55.8	148	114.4	93.9	208	160.8	132.0	268	207.2	170.0
29	22.4	18.4	89	68.8	56.5	149	115.2	94.5	209	161.6	132.6	269	207.9	170.6
30	23.2	19.0	90	69.6	57.1	150	115.9	95.2	210	162.3	133.2	270	208.7	171.3
31	24.0	19.7	91	70.3	57.7	151	116.7	95.8	211	163.1	133.9	271	209.5	171.9
32	24.7	20.3	92	71.1	58.4	152	117.5	96.4	212	163.9	134.5	272	210.3	172.6
33	25.5	20.9	93	71.9	59.0	153	118.3	97.1	213	164.6	135.1	273	211.0	173.2
34	26.3	21.6	94	72.7	59.6	154	119.0	97.7	214	165.4	135.8	274	211.8	173.8
35	27.1	22.2	95	73.4	60.3	155	119.8	98.3	215	166.2	136.4	275	212.6	174.5
36	27.8	22.8	96	74.2	60.9	156	120.6	99.0	216	167.0	137.0	276	213.3	175.1
37	28.6	23.5	97	75.0	61.5	157	121.4	99.6	217	167.7	137.7	277	214.1	175.7
38	29.4	24.1	98	75.7	62.2	158	122.1	100.2	218	168.5	138.3	278	214.9	176.4
39	30.1	24.7	99	76.5	62.8	159	122.9	100.9	219	169.3	138.9	279	215.7	177.0
40	30.9	25.4	100	77.3	63.4	160	123.7	101.5	220	170.1	139.6	280	216.4	177.6
41	31.7	26.0	101	78.1	64.1	161	124.4	102.1	221	170.8	140.2	281	217.2	178.3
42	32.5	26.6	102	78.8	64.7	162	125.2	102.8	222	171.6	140.8	282	218.0	178.9
43	33.2	27.3	103	79.6	65.3	163	126.0	103.4	223	172.4	141.5	283	218.8	179.5
44	34.0	27.9	104	80.4	66.0	164	126.8	104.0	224	173.1	142.1	284	219.5	180.2
45	34.8	28.5	105	81.2	66.6	165	127.5	104.7	225	173.9	142.7	285	220.3	180.8
46	35.6	29.2	106	81.9	67.2	166	128.3	105.3	226	174.7	143.4	286	221.1	181.4
47	36.3	29.8	107	82.7	67.9	167	129.1	105.9	227	175.5	144.0	287	221.8	182.1
48	37.1	30.4	108	83.5	68.5	168	129.9	106.6	228	176.2	144.6	288	222.6	182.7
49	37.9	31.1	109	84.3	69.1	169	130.6	107.2	229	177.0	145.3	289	223.4	183.3
50	38.6	31.7	110	85.0	69.8	170	131.4	107.8	230	177.8	145.9	290	224.2	184.0
51	39.4	32.3	111	85.8	70.4	171	132.2	108.5	231	178.6	146.5	291	224.9	184.6
52	40.2	33.0	112	86.6	71.0	172	133.0	109.1	232	179.3	147.2	292	225.7	185.2
53	41.0	33.6	113	87.3	71.7	173	133.7	109.7	233	180.1	147.8	293	226.5	185.9
54	41.7	34.3	114	88.1	72.3	174	134.5	110.4	234	180.9	148.4	294	227.3	186.5
55	42.5	34.9	115	88.9	73.0	175	135.3	111.0	235	181.7	149.1	295	228.0	187.1
56	43.3	35.5	116	89.7	73.6	176	136.0	111.6	236	182.4	149.7	296	228.8	187.8
57	44.1	36.2	117	90.4	74.2	177	136.8	112.3	237	183.2	150.3	297	229.6	188.4
58	44.8	36.8	118	91.2	74.9	178	137.6	112.9	238	184.0	151.0	298	230.4	189.0
59	45.6	37.4	119	92.0	75.5	179	138.4	113.6	239	184.7	151.6	299	231.1	189.7
60	46.4	38.1	120	92.8	76.1	180	139.1	114.2	240	185.5	152.3	300	231.9	190.3
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 4 ½ Points.

TABLE I.

Difference of Latitude and Departure for 3 ¾ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	45.2	41.0	121	89.6	81.3	181	134.1	121.5	241	178.6	161.8
2	01.5	01.3	62	45.9	41.6	122	90.4	81.9	182	134.8	122.2	242	179.3	162.5
3	02.2	02.0	63	46.7	42.3	123	91.1	82.6	183	135.6	122.9	243	180.0	163.2
4	03.0	02.7	64	47.4	43.0	124	91.9	83.3	184	136.3	123.6	244	180.8	163.8
5	03.7	03.4	65	48.2	43.6	125	92.6	83.9	185	137.1	124.2	245	181.5	164.5
6	04.4	04.0	66	48.9	44.3	126	93.4	84.6	186	137.8	124.9	246	182.3	165.2
7	05.2	04.7	67	49.6	45.0	127	94.1	85.3	187	138.6	125.6	247	183.0	165.9
8	05.9	05.4	68	50.4	45.7	128	94.8	86.0	188	139.3	126.2	248	183.8	166.5
9	06.7	06.0	69	51.1	46.3	129	95.6	86.6	189	140.0	126.9	249	184.5	167.2
10	07.4	06.7	70	51.9	47.0	130	96.3	87.3	190	140.8	127.6	250	185.2	167.9
11	08.2	07.4	71	52.6	47.7	131	97.1	88.0	191	141.5	128.3	251	186.0	168.5
12	08.9	08.1	72	53.3	48.3	132	97.8	88.6	192	142.3	128.9	252	186.7	169.2
13	09.6	08.7	73	54.1	49.0	133	98.5	89.3	193	143.0	129.6	253	187.5	169.9
14	10.4	09.4	74	54.8	49.7	134	99.3	90.0	194	143.7	130.3	254	188.2	170.6
15	11.1	10.1	75	55.6	50.4	135	100.0	90.7	195	144.5	130.9	255	188.9	171.2
16	11.9	10.7	76	56.3	51.0	136	100.8	91.3	196	145.2	131.6	256	189.7	171.9
17	12.6	11.4	77	57.0	51.7	137	101.5	92.0	197	146.0	132.3	257	190.4	172.6
18	13.3	12.1	78	57.8	52.4	138	102.2	92.7	198	146.7	133.0	258	191.2	173.2
19	14.1	12.8	79	58.5	53.0	139	103.0	93.3	199	147.4	133.6	259	191.9	173.9
20	14.8	13.4	80	59.3	53.7	140	103.7	94.0	200	148.2	134.3	260	192.6	174.6
21	15.6	14.1	81	60.0	54.4	141	104.5	94.7	201	148.9	135.0	261	193.4	175.3
22	16.3	14.8	82	60.8	55.1	142	105.2	95.4	202	149.7	135.6	262	194.1	175.9
23	17.0	15.4	83	61.5	55.7	143	106.0	96.0	203	150.4	136.3	263	194.9	176.6
24	17.8	16.1	84	62.2	56.4	144	106.7	96.7	204	151.1	137.0	264	195.6	177.3
25	18.5	16.8	85	63.0	57.1	145	107.4	97.4	205	151.9	137.7	265	196.3	178.0
26	19.3	17.5	86	63.7	57.7	146	108.2	98.0	206	152.6	138.3	266	197.1	178.6
27	20.0	18.1	87	64.5	58.4	147	108.9	98.7	207	153.4	139.0	267	197.8	179.3
28	20.7	18.8	88	65.2	59.1	148	109.7	99.4	208	154.1	139.7	268	198.6	180.0
29	21.5	19.5	89	65.9	59.8	149	110.4	100.1	209	154.9	140.3	269	199.3	180.6
30	22.2	20.1	90	66.7	60.4	150	111.1	100.7	210	155.6	141.0	270	200.1	181.3
31	23.0	20.8	91	67.4	61.1	151	111.9	101.4	211	156.3	141.7	271	200.8	182.0
32	23.7	21.5	92	68.2	61.8	152	112.6	102.1	212	157.1	142.4	272	201.5	182.7
33	24.4	22.2	93	68.9	62.4	153	113.4	102.7	213	157.8	143.0	273	202.3	183.3
34	25.2	22.8	94	69.6	63.1	154	114.1	103.4	214	158.6	143.7	274	203.0	184.0
35	25.9	23.5	95	70.4	63.8	155	114.8	104.1	215	159.3	144.4	275	203.8	184.7
36	26.7	24.2	96	71.1	64.5	156	115.6	104.8	216	160.0	145.0	276	204.5	185.3
37	27.4	24.8	97	71.9	65.1	157	116.3	105.4	217	160.8	145.7	277	205.2	186.0
38	28.2	25.5	98	72.6	65.8	158	117.1	106.1	218	161.5	146.4	278	206.0	186.7
39	28.9	26.2	99	73.3	66.5	159	117.8	106.8	219	162.3	147.1	279	206.7	187.4
40	29.6	26.9	100	74.1	67.2	160	118.5	107.4	220	163.0	147.7	280	207.5	188.0
41	30.4	27.5	101	74.8	67.8	161	119.3	108.1	221	163.7	148.4	281	208.2	188.7
42	31.1	28.2	102	75.6	68.5	162	120.0	108.8	222	164.5	149.1	282	208.9	189.4
43	31.9	28.9	103	76.3	69.2	163	120.8	109.5	223	165.2	149.7	283	209.7	190.0
44	32.6	29.5	104	77.1	69.8	164	121.5	110.1	224	166.0	150.4	284	210.4	190.7
45	33.3	30.2	105	77.8	70.5	165	122.3	110.8	225	166.7	151.1	285	211.2	191.4
46	34.1	30.9	106	78.5	71.2	166	123.0	111.5	226	167.4	151.8	286	211.9	192.1
47	34.8	31.6	107	79.3	71.8	167	123.7	112.1	227	168.2	152.4	287	212.6	192.7
48	35.6	32.2	108	80.0	72.5	168	124.5	112.8	228	168.9	153.1	288	213.4	193.4
49	36.3	32.9	109	80.8	73.2	169	125.2	113.5	229	169.7	153.8	289	214.1	194.1
50	37.0	33.6	110	81.5	73.9	170	126.0	114.2	230	170.4	154.5	290	214.9	194.7
51	37.8	34.2	111	82.2	74.5	171	126.7	114.8	231	171.2	155.1	291	215.6	195.4
52	38.5	34.9	112	83.0	75.2	172	127.4	115.5	232	171.9	155.8	292	216.4	196.1
53	39.3	35.6	113	83.7	75.9	173	128.2	116.2	233	172.6	156.5	293	217.1	196 8
54	40.0	36.3	114	84.5	76.5	174	128.9	116.8	234	173.4	157.1	294	217.8	197.4
55	40.7	36.9	115	85.2	77.2	175	129.7	117.5	235	174.1	157.8	295	218.6	198.1
56	41.5	37.6	116	85.9	77.9	176	130.4	118.2	236	174.9	158.5	296	219.3	198.8
57	42.2	38.3	117	86.7	78.6	177	131.1	118.9	237	175.6	159.1	297	220.1	199.4
58	43.0	38.9	118	87.4	79.2	178	131.9	119.5	238	176.3	159.8	298	220.8	200.1
59	43.7	39.6	119	88.2	79.9	179	132.6	120.2	239	177.1	160.5	299	221.5	200.8
60	44.5	40.3	120	88.9	80.6	180	133.4	120.9	240	177.8	161.2	300	222.3	201.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 4 ¼ Points.

TABLE I

Difference of Latitude and Departure for 4 Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	43.1	43.1	121	85.6	85.6	181	128.0	128.0	241	170.4	170.4
2	01.4	01.4	62	43.8	43.8	122	86.3	86.3	182	128.7	128.7	242	171.1	171.1
3	02.1	02.1	63	44.5	44.5	123	87.0	87.0	183	129.4	129.4	243	171.8	171.8
4	02.8	02.8	64	45.3	45.3	124	87.7	87.7	184	130.1	130.1	244	172.5	172.5
5	03.5	03.5	65	46.0	46.0	125	88.4	88.4	185	130.8	130.8	245	173.2	173.2
6	04.2	04.2	66	46.7	46.7	126	89.1	89.1	186	131.5	131.5	246	173.9	173.9
7	04.9	04.9	67	47.4	47.4	127	89.8	89.8	187	132.2	132.2	247	174.7	174.7
8	05.7	05.7	68	48.1	48.1	128	90.5	90.5	188	132.9	132.9	248	175.4	175.4
9	06.4	06.4	69	48.8	48.8	129	91.2	91.2	189	133.6	133.6	249	176.1	176.1
10	07.1	07.1	70	49.5	49.5	130	91.9	91.9	190	134.3	134.3	250	176.8	176 8
11	07.8	07.8	71	50.2	50.2	131	92.6	92.6	191	135.1	135.1	251	177.5	177.5
12	08.5	08.5	72	50.9	50.9	132	93.3	93.3	192	135.8	135.8	252	178.2	178.2
13	09.2	09.2	73	51.6	51.6	133	94.0	94.0	193	136.5	136.5	253	178.9	178.9
14	09.9	09.9	74	52.3	52.3	134	94.8	94.8	194	137.2	137.2	254	179.6	179.6
15	10.6	10.6	75	53.0	53.0	135	95.5	95.5	195	137.9	137.9	255	180.3	180.3
16	11.3	11.3	76	53.7	53.7	136	96.2	96.2	196	138.6	138.6	256	181.0	181.0
17	12.0	12.0	77	54.4	54.4	137	96.9	96.9	197	139.3	139.3	257	181.7	181.7
18	12.7	12.7	78	55.2	55.2	138	97.6	97.6	198	140.0	140.0	258	182.4	182.4
19	13.4	13.4	79	55.9	55.9	139	98.3	98.3	199	140.7	140.7	259	183.1	183.1
20	14.1	14.1	80	56.6	56.6	140	99.0	99.0	200	141.4	141.4	260	183.8	183.8
21	14.8	14.8	81	57.3	57.3	141	99.7	99.7	201	142.1	142.1	261	184.6	184.6
22	15.6	15.6	82	58.0	58.0	142	100.4	100.4	202	142.8	142.8	262	185.3	185.3
23	16.3	16.3	83	58.7	58.7	143	101.1	101.1	203	143.5	143.5	263	186.0	186.0
24	17.0	17.0	84	59.4	59.4	144	101.8	101.8	204	144.2	144.2	264	186.7	186.7
25	17.7	17.7	85	60.1	60.1	145	102.5	102.5	205	145.0	145.0	265	187.4	187.4
26	18.4	18.4	86	60.8	60.8	146	103.2	103.2	206	145.7	145.7	266	188.1	188.1
27	19.1	19.1	87	61.5	61 5	147	103.9	103.9	207	146.4	146.4	267	188.8	188.8
28	19.8	19.8	88	62.2	62.2	148	104.7	104.7	208	147.1	147.1	268	189.5	189.5
29	20.5	20.5	89	62.9	62.9	149	105.4	105.4	209	147.8	147.8	269	190.2	190.2
30	21.2	21.2	90	63.6	63.6	150	106.1	106.1	210	148.5	148.5	270	190.9	190.9
31	21.9	21.9	91	64.3	64.3	151	106.8	106.8	211	149.2	149.2	271	191.6	191.6
32	22.6	22.6	92	65.1	65.1	152	107.5	107.5	212	149.9	149.9	272	192.3	192.3
33	23.3	23.3	93	65.8	65.8	153	108.2	108.2	213	150.6	150.6	273	193.0	193.0
34	24.0	24.0	94	66.5	66.5	154	108.9	108.9	214	151.3	151.3	274	193.7	193.7
35	24.7	24.7	95	67.2	67.2	155	109.6	109.6	215	152.0	152.0	275	194.5	194.5
36	25.5	25.5	96	67.9	67.9	156	110.3	110.3	216	152.7	152.7	276	195.2	195.2
37	26.2	26.2	97	68.6	68.6	157	111.0	111.0	217	153.4	153.4	277	195.9	195.9
38	26.9	26.9	98	69.3	69.3	158	111.7	111.7	218	154.1	154.1	278	196.6	196.6
39	27.6	27.6	99	70.0	70.0	159	112.4	112.4	219	154.9	154.9	279	197.3	197.3
40	28.3	28.3	100	70.7	70.7	160	113.1	113.1	220	155.6	155.6	280	198.0	198.0
41	29.0	29.0	101	71.4	71.4	161	113.8	113.8	221	156.3	156.3	281	198.7	198.7
42	29.7	29.7	102	72.1	72.1	162	114.5	114.5	222	157.0	157.0	282	199.4	199.4
43	30.4	30.4	103	72.8	72.8	163	115.3	115.3	223	157.7	157.7	283	200.1	200.1
44	31.1	31.1	104	73.5	73.5	164	116.0	116.0	224	158.4	158.4	284	200.8	200.8
45	31.8	31.8	105	74.2	74.2	165	116.7	116.7	225	159.1	159.1	285	201.5	201.5
46	32.5	32.5	106	75.0	75.0	166	117.4	117.4	226	159.8	159.8	286	202.2	202.2
47	33.2	33.2	107	75.7	75.7	167	118.1	118.1	227	160.5	160.5	287	202.9	202.9
48	33.9	33.9	108	76.4	76.4	168	118.8	118.8	228	161.2	161.2	288	203.6	203.6
49	34.6	34.6	109	77.1	77.1	169	119.5	119.5	229	161.9	161.9	289	204.3	204.3
50	35.4	35.4	110	77.8	77.8	170	120.2	120.2	230	162.6	162.6	290	205.1	205.1
51	36.1	36.1	111	78.5	78.5	171	120.9	120.9	231	163.3	163.3	291	205.8	205.8
52	36.8	36.8	112	79.2	79.2	172	121.6	121.6	232	164.0	164.0	292	206.5	206.5
53	37.5	37.5	113	79.9	79.9	173	122.3	122.3	233	164.8	164.8	293	207.2	207.2
54	38.2	38.2	114	80.6	80.6	174	123.0	123.0	234	165.5	165.5	294	207.9	207.9
55	38.9	38.9	115	81.3	81.3	175	123.7	123.7	235	166.2	166.2	295	208.6	208.6
56	39.6	39.6	116	82.0	82.0	176	124.4	124.4	236	166.9	166.9	296	209.3	209.3
57	40.3	40.3	117	82.7	82.7	177	125.2	125.2	237	167.6	167.6	297	210.0	210.0
58	41.0	41.0	118	83.4	83.4	178	125.9	125.9	238	168.3	168.3	298	210.7	210.7
59	41.7	41.7	119	84.1	84.1	179	126.6	126.6	239	169.0	169.0	299	211.4	211.4
60	42.4	42.4	120	84.8	84.8	180	127.3	127.3	240	169.7	169.7	300	212.1	212.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE II.

Difference of Latitude and Departure for 1 Degree.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.0	61	61.0	01.1	121	121.0	02.1	181	181.0	03.2	241	241.0	04.2
2	02.0	00.0	62	62.0	01.1	122	122.0	02.1	182	182.0	03.2	242	242.0	04.2
3	03.0	00.1	63	63.0	01.1	123	123.0	02.1	183	183.0	03.2	243	243.0	04.2
4	04.0	00.1	64	64.0	01.1	124	124.0	02.2	184	184.0	03.2	244	244.0	04.3
5	05.0	00.1	65	65.0	01.1	125	125.0	02.2	185	185.0	03.2	245	245.0	04.3
6	06.0	00.1	66	66.0	01.2	126	126.0	02.2	186	186.0	03.2	246	246.0	04.3
7	07.0	00.1	67	67.0	01.2	127	127.0	02.2	187	187.0	03.3	247	247.0	04.3
8	08.0	00.1	68	68.0	01.2	128	128.0	02.2	188	188.0	03.3	248	248.0	04.3
9	09.0	00.2	69	69.0	01.2	129	129.0	02.3	189	189.0	03.3	249	249.0	04.3
10	10.0	00.2	70	70.0	01.2	130	130.0	02.3	190	190.0	03.3	250	250.0	04.4
11	11.0	00.2	71	71.0	01.2	131	131.0	02.3	191	191.0	03.3	251	251.0	04.4
12	12.0	00.2	72	72.0	01.3	132	132.0	02.3	192	192.0	03.4	252	252.0	04.4
13	13.0	00.2	73	73.0	01.3	133	133.0	02.3	193	193.0	03.4	253	253.0	04.4
14	14.0	00.2	74	74.0	01.3	134	134.0	02.3	194	194.0	03.4	254	254.0	04.4
15	15.0	00.3	75	75.0	01.3	135	135.0	02.4	195	195.0	03.4	255	255.0	04.5
16	16.0	00.3	76	76.0	01.3	136	136.0	02.4	196	196.0	03.4	256	256.0	04.5
17	17.0	00.3	77	77.0	01.3	137	137.0	02.4	197	197.0	03.4	257	257.0	04.5
18	18.0	00.3	78	78.0	01.4	138	138.0	02.4	198	198.0	03.5	258	258.0	04.5
19	19.0	00.3	79	79.0	01.4	139	139.0	02.4	199	199.0	03.5	259	259.0	04.5
20	20.0	00.3	80	80.0	01.4	140	140.0	02.4	200	200.0	03.5	260	260.0	04.5
21	21.0	00.4	81	81.0	01.4	141	141.0	02.5	201	201.0	03.5	261	261.0	04.6
22	22.0	00.4	82	82.0	01.4	142	142.0	02.5	202	202.0	03.5	262	262.0	04.6
23	23.0	00.4	83	83.0	01.4	143	143.0	02.5	203	203.0	03.5	263	263.0	04.6
24	24.0	00.4	84	84.0	01.5	144	144.0	02.5	204	204.0	03.6	264	264.0	04.6
25	25.0	00.4	85	85.0	01.5	145	145.0	02.5	205	205.0	03.6	265	265.0	04.6
26	26.0	00.5	86	86.0	01.5	146	146.0	02.5	206	206.0	03.6	266	266.0	04.6
27	27.0	00.5	87	87.0	01.5	147	147.0	02.6	207	207.0	03.6	267	267.0	04.7
28	28.0	00.5	88	88.0	01.5	148	148.0	02.6	208	208.0	03.6	268	268.0	04.7
29	29.0	00.5	89	89.0	01.6	149	149.0	02.6	209	209.0	03.6	269	269.0	04.7
30	30.0	00.5	90	90.0	01.6	150	150.0	02.6	210	210.0	03.7	270	270.0	04.7
31	31.0	00.5	91	91.0	01.6	151	151.0	02.6	211	211.0	03.7	271	271.0	04.7
32	32.0	00.6	92	92.0	01.6	152	152.0	02.7	212	212.0	03.7	272	272.0	04.7
33	33.0	00.6	93	93.0	01.6	153	153.0	02.7	213	213.0	03.7	273	273.0	04.8
34	34.0	00.6	94	94.0	01.6	154	154.0	02.7	214	214.0	03.7	274	274.0	04.8
35	35.0	00.6	95	95.0	01.7	155	155.0	02.7	215	215.0	03.8	275	275.0	04.8
36	36.0	00.6	96	96.0	01.7	156	156.0	02.7	216	216.0	03.8	276	276.0	04.8
37	37.0	00.6	97	97.0	01.7	157	157.0	02.7	217	217.0	03.8	277	277.0	04.8
38	38.0	00.7	98	98.0	01.7	158	158.0	02.8	218	218.0	03.8	278	278.0	04.9
39	39.0	00.7	99	99.0	01.7	159	159.0	02.8	219	219.0	03.8	279	279.0	04.9
40	40.0	00.7	100	100.0	01.7	160	160.0	02.8	220	220.0	03.8	280	280.0	04.9
41	41.0	00.7	101	101.0	01.8	161	161.0	02.8	221	221.0	03.9	281	281.0	04.9
42	42.0	00.7	102	102.0	01.8	162	162.0	02.8	222	222.0	03.9	282	282.0	04.9
43	43.0	00.8	103	103.0	01.8	163	163.0	02.8	223	223.0	03.9	283	283.0	04.9
44	44.0	00.8	104	104.0	01.8	164	164.0	02.9	224	224.0	03.9	284	284.0	05.0
45	45.0	00.8	105	105.0	01.8	165	165.0	02.9	225	225.0	03.9	285	285.0	05.0
46	46.0	00.8	106	106.0	01.8	166	166.0	02.9	226	226.0	03.9	286	286.0	05.0
47	47.0	00.8	107	107.0	01.9	167	167.0	02.9	227	227.0	04.0	287	287.0	05.0
48	48.0	00.8	108	108.0	01.9	168	168.0	02.9	228	228.0	04.0	288	288.0	05.0
49	49.0	00.9	109	109.0	01.9	169	169.0	02.9	229	229.0	04.0	289	289.0	05.0
50	50.0	00.9	110	110.0	01.9	170	170.0	03.0	230	230.0	04.0	290	290.0	05.1
51	51.0	00.9	111	111.0	01.9	171	171.0	03.0	231	231.0	04.0	291	291.0	05.1
52	52.0	00.9	112	112.0	02.0	172	172.0	03.0	232	232.0	04.0	292	292.0	05.1
53	53.0	00.9	113	113.0	02.0	173	173.0	03.0	233	233.0	04.1	293	293.0	05.1
54	54.0	00.9	114	114.0	02.0	174	174.0	03.0	234	234.0	04.1	294	294.0	05.1
55	55.0	01.0	115	115.0	02.0	175	175.0	03.1	235	235.0	04.1	295	295.0	05.1
56	56.0	01.0	116	116.0	02.0	176	176.0	03.1	236	236.0	04.1	296	296.0	05.2
57	57.0	01.0	117	117.0	02.0	177	177.0	03.1	237	237.0	04.1	297	297.0	05.2
58	58.0	01.0	118	118.0	02.1	178	178.0	03.1	238	238.0	04.2	298	298.0	05.2
59	59.0	01.0	119	119.0	02.1	179	179.0	03.1	239	239.0	04.2	299	299.0	05.2
60	60.0	01.0	120	120.0	02.1	180	180.0	03.1	240	240.0	04.2	300	300.0	05.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 89 Degrees.

TABLE II.

Difference of Latitude and Departure for 2 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep
1	01.0	00.0	61	61.0	02.1	121	120.9	04.2	181	180.9	06.3	241	240.9	08.4
2	02.0	00.1	62	62.0	02.2	122	121.9	04.3	182	181.9	06.4	242	241.9	08.4
3	03.0	00.1	63	63.0	02.2	123	122.9	04.3	183	182.9	06.4	243	242.9	08.5
4	04.0	00.1	64	64.0	02.2	124	123.9	04.3	184	183.9	06.4	244	243.9	08.5
5	05.0	00.2	65	65.0	02.3	125	124.9	04.4	185	184.9	06.5	245	244.9	08.6
6	06.0	00.2	66	66.0	02.3	126	125.9	04.4	186	185.9	06.5	246	245.9	08.6
7	07.0	00.2	67	67.0	02.3	127	126.9	04.4	187	186.9	06.5	247	246.8	08.6
8	08.0	00.3	68	68.0	02.4	128	127.9	04.5	188	187.9	06.6	248	247.8	08.7
9	09.0	00.3	69	69.0	02.4	129	128.9	04.5	189	188.9	06.6	249	248.8	08.7
10	10.0	00.3	70	70.0	02.4	130	129.9	04.5	190	189.9	06.6	250	249.8	08.7
11	11.0	00.4	71	71.0	02.5	131	130.9	04.6	191	190.9	06.7	251	250.8	08.8
12	12.0	00.4	72	72.0	02.5	132	131.9	04.6	192	191.9	06.7	252	251.8	08.8
13	13.0	00.5	73	73.0	02.5	133	132.9	04.6	193	192.9	06.7	253	252.8	08.8
14	14.0	00.5	74	74.9	02.6	134	133.9	04.7	194	193.9	06.8	254	253.8	08.9
15	15.0	00.5	75	75.0	02.6	135	134.9	04.7	195	194.9	06.8	255	254.8	08.9
16	16.0	00.6	76	76.0	02.7	136	135.9	04.7	196	195.9	06 8	256	255.8	08.9
17	17.0	00.6	77	77.0	02.7	137	136.9	04.8	197	196.9	06.9	257	256.8	09.0
18	18.0	00.6	78	78.0	02.7	138	137.9	04.8	198	197.9	06.9	258	257.8	09.0
19	19.0	00.7	79	79.0	02.8	139	138.9	04.9	199	198.9	06.9	259	258.8	09.0
20	20.0	00.7	80	80.0	02.8	140	139.9	04.9	200	199.9	07.0	260	259.8	09.1
21	21.0	00.7	81	81.0	02.8	141	140.9	04.9	201	200.9	07.0	261	260.8	09.1
22	22.0	00.8	82	82.0	02.9	142	141.9	05.0	202	201.9	07.0	262	261.8	09.1
23	23.0	00.8	83	82.9	02.9	143	142.9	05.0	203	202.9	07.1	263	262.8	09.2
24	24.0	00.8	84	83.9	02.9	144	143.9	05.0	204	203.9	07.1	264	263.8	09.2
25	25.0	00.9	85	84.9	03.0	145	144.9	05.1	205	204.9	07.2	265	264.8	09.2
26	26.0	00.9	86	85.9	03.0	146	145.9	05.1	206	205.9	07.2	266	265.8	09.3
27	27.0	00.9	87	86.9	03.0	147	146.9	05.1	207	206.9	07.2	267	266.8	09.3
28	28.0	01.0	88	87.9	03.1	148	147.9	05.2	208	207.9	07.3	268	267.8	09.4
29	29.0	01.0	89	88.9	03.1	149	148.9	05.2	209	208.9	07.3	269	268.8	09.4
30	30.0	01.0	90	89.9	03.1	150	149.9	05.2	210	209.9	07.3	270	269.8	09.4
31	31.0	01.1	91	90.9	03.2	151	150.9	05.3	211	210.9	07.4	271	270.8	09.5
32	32.0	01.1	92	91.9	03.2	152	151.9	05.3	212	211.9	07.4	272	271.8	09.5
33	33.0	01.2	93	92.9	03.2	153	152.9	05.3	213	212.9	07.4	273	272.8	09.5
34	34.0	01.2	94	93.9	03.3	154	153.9	05.4	214	213.9	07.5	274	273.8	09 6
35	35.0	01.2	95	94.9	03.3	155	154.9	05.4	215	214.9	07.5	275	274.8	09.6
36	36.0	01.3	96	95.9	03.4	156	155.9	05.4	216	215.9	07.5	276	275.8	09.6
37	37.0	01.3	97	96.9	03.4	157	156.9	05.5	217	216.9	07.6	277	276.8	09.7
38	38.0	01.3	98	97.9	03.4	158	157.9	05.5	218	217.9	07.6	278	277.8	09.7
39	39.0	01.4	99	98.9	03.5	159	158.9	05.5	219	218.9	07.6	279	278.8	09.7
40	40.0	01.4	100	99.9	03.5	160	159.9	05.6	220	219.9	07.7	280	279.8	09.8
41	41.0	01.4	101	100.9	03.5	161	160.9	05.6	221	220.9	07.7	281	280.8	09.8
42	42.0	01.5	102	101.9	03.6	162	161.9	05.7	222	221.9	07.7	282	281.8	09.8
43	43.0	01.5	103	102.9	03.6	163	162.9	05.7	223	222.9	07.8	283	282.8	09.9
44	44.0	01.5	104	103.9	03.6	164	163.9	05.7	224	223.9	07.8	284	283.8	09.9
45	45.0	01.6	105	104.9	03.7	165	164.9	05.8	225	224.9	07.9	285	284.8	09.9
46	46.0	01.6	106	105.9	03.7	166	165.9	05.8	226	225.9	07.9	286	285.8	10.0
47	47.0	01.6	107	106.9	03.7	167	166.9	05.8	227	226.9	07.9	287	286.8	10.0
48	48.0	01.7	108	107.9	03.8	168	167.9	05.9	228	227.9	08.0	288	287.8	10.1
49	49.0	01.7	109	108.9	03.8	169	168.9	05.9	229	228.9	08.0	289	288.8	10.1
50	50.0	01.7	110	109.9	03.8	170	169.9	05.9	230	229.9	08.0	290	289.8	10.1
51	51.0	01.8	111	110.9	03.9	171	170.9	06.0	231	230.9	08.1	291	290.8	10.2
52	52.0	01.8	112	111.9	03.9	172	171.9	06.0	232	231.9	08.1	292	291.8	10.2
53	53.0	01.8	113	112.9	03.9	173	172.9	06.0	233	232.9	08.1	293	292.8	10.2
54	54.0	01.9	114	113.9	04.0	174	173.9	06.1	234	233.9	08.2	294	293.8	10.3
55	55.0	01.9	115	114.9	04.0	175	174.9	06.1	235	234.9	08.2	295	294.8	10.3
56	56.0	02.0	116	115.9	04.0	176	175.9	06.1	236	235.9	08.2	296	295.8	10.3
57	57.0	02.0	117	116.9	04.1	177	176.9	06.2	237	236.9	08.3	297	296.8	10.4
58	58.0	02.0	118	117.9	04.1	178	177.9	06.2	238	237.9	08.3	298	297.8	10.4
59	59.0	02.1	119	118.9	04.2	179	178.9	06.2	239	238.9	08.3	299	298.8	10.4
60	60.0	02.1	120	119.9	04.2	180	179.9	06.3	240	239.9	08.4	300	299.8	10.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 88 Degrees.

TABLE II.

Difference of Latitude and Departure for 8 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.9	03.2	121	120.8	06.3	181	180.8	09.5	241	240.7	12.6
2	02.0	00.1	62	61.9	03.2	122	121.8	06.4	182	181.8	09.5	242	241.7	12.7
3	03.0	00.2	63	62.9	03.3	123	122.8	06.4	183	182.7	09.6	243	242.7	12.7
4	04.0	00.2	64	63.9	03.3	124	123.8	06.5	184	183.7	09.6	244	243.7	12.8
5	05.0	00.3	65	64.9	03.4	125	124.8	06.5	185	184.7	09.7	245	244.7	12.8
6	06.0	00.3	66	65.9	03.5	126	125.8	06.6	186	185.7	09.7	246	245.7	12.9
7	07.0	00.4	67	66.9	03.5	127	126.8	06.6	187	186.7	09.8	247	246.7	12.9
8	08.0	00 4	68	67.9	03.6	128	127.8	06.7	188	187.7	09.8	248	247.7	13.0
9	09.0	00.5	69	68.9	03.6	129	128.8	06.8	189	188.7	09.9	249	248.7	13.0
10	10.0	00.5	70	69.9	03.7	130	129.8	06.8	190	189.7	09.9	250	249.7	13.1
11	11.0	00.6	71	70.9	03.7	131	130.8	06.9	191	190.7	10.0	251	250.7	13.1
12	12.0	00.6	72	71.9	03.8	132	131.8	06.9	192	191.7	10.0	252	251.7	13.2
13	13.0	00.7	73	72.9	03.8	133	132.8	07.0	193	192.7	10.1	253	252.7	13.2
14	14.0	00.7	74	73.9	03.9	134	133.8	07.0	194	193.7	10.2	254	253.7	13.3
15	15.0	00.8	75	74.9	03.9	135	134.8	07.1	195	194.7	10.2	255	254.7	13.3
16	16.0	00.8	76	75.9	04.0	136	135.8	07.1	196	195.7	10.3	256	255.6	13.4
17	17.0	00.9	77	76.9	04.0	137	136.8	07.2	197	196.7	10.3	257	256.6	13.5
18	18.0	00.9	78	77.9	04.1	138	137.8	07.2	198	197.7	10.4	258	257.6	13.5
19	19.0	01.0	79	78.9	04.1	139	138.8	07.3	199	198.7	10.4	259	258.6	13.6
20	20.0	01.0	80	79.9	04.2	140	139.8	07.3	200	199.7	10.5	260	259.6	13.6
21	21.0	01.1	81	80.9	04.2	141	140.8	07.4	201	200.7	10.5	261	260.6	13.7
22	22.0	01.2	82	81.9	04.3	142	141.8	07.4	202	201.7	10.6	262	261.6	13.7
23	23.0	01.2	83	82.9	04.3	143	142.8	07.5	203	202.7	10.6	263	262.6	13.8
24	24.0	01.3	84	83.9	04.4	144	143.8	07.5	204	203.7	10.7	264	263.6	13.8
25	25.0	01.3	85	84.9	04.4	145	144.8	07.6	205	204.7	10.7	265	264.6	13.9
26	26.0	01.4	86	85.9	04.5	146	145.8	07.6	206	205.7	10.8	266	265.6	13.9
27	27.0	01.4	87	86.9	04.6	147	146.8	07.7	207	206.7	10.8	267	266.6	14.0
28	28.0	01.5	88	87.9	04.6	148	147.8	07.7	208	207.7	10.9	268	267.6	14.0
29	29.0	01 5	89	88.9	04.7	149	148.8	07.8	209	208.7	10.9	269	268.6	14.1
30	30.0	01 6	90	89.9	04.7	150	149.8	07.9	210	209.7	11.0	270	269.6	14.1
31	31.0	01.6	91	90.9	04.8	151	150.8	07.9	211	210.7	11.0	271	270.6	14.2
32	32.0	01.7	92	91.9	04.8	152	151.8	08.0	212	211.7	11.1	272	271.6	14.2
33	33.0	01.7	93	92.9	04.9	153	152.8	08.0	213	212.7	11.1	273	272.6	14.3
34	34.0	01.8	94	93.9	04.9	154	153.8	08.1	214	213.7	11.2	274	273.6	14.3
35	35.0	01.8	95	94.9	05.0	155	154.8	08.1	215	214.7	11.3	275	274.6	14.4
36	36.0	01.9	96	95.9	05.0	156	155.8	08.2	216	215.7	11.3	276	275.6	14.4
37	36.9	01.9	97	96.9	05.1	157	156.8	08.2	217	216.7	11.4	277	276.6	14.5
38	37.9	02.0	98	97.9	05.1	158	157.8	08.3	218	217.7	11.4	278	277.6	14.5
39	38.9	02.0	99	98.9	05.2	159	158.8	08.3	219	218.7	11.5	279	278.6	14.6
40	39.9	02.1	100	99.9	05.2	160	159.8	08.4	220	219.7	11.5	280	279.6	14.7
41	40.9	02.1	101	100.9	05.3	161	160.8	08.4	221	220.7	11.6	281	280.6	14.7
42	41.9	02.2	102	101.9	05.3	162	161.8	08.5	222	221.7	11.6	282	281.6	14.8
43	42.9	02.3	103	102.9	05.4	163	162.8	08.5	223	222.7	11.7	283	282.6	14.8
44	43.9	02.3	104	103.9	05.4	164	163.8	08.6	224	223.7	11.7	284	283.6	14.9
45	44.9	02.4	105	104.9	05.5	165	164.8	08.6	225	224.7	11.8	285	284.6	14.9
46	45.9	02.4	106	105.9	05.5	166	165.8	08.7	226	225.7	11.8	286	285.6	15.0
47	46.9	02.5	107	106.9	05.6	167	166.8	08.7	227	226.7	11.9	287	286.6	15.0
48	47.9	02.5	108	107.9	05.7	168	167.8	08.8	228	227.7	11.9	288	287.6	15.1
49	48.9	02.6	109	108.9	05.7	169	168.8	08.8	229	228.7	12.0	289	288.6	15.1
50	49.9	02.6	110	109.8	05.8	170	169.8	08.9	230	229.7	12.0	290	289.6	15.2
51	50.9	02.7	111	110.8	05.8	171	170.8	08.9	231	230.7	12.1	291	290.6	15.2
52	51.9	02.7	112	111.8	05.9	172	171.8	09.0	232	231.7	12.1	292	291.6	15.3
53	52.9	02.8	113	112.8	05.9	173	172.8	09.1	233	232.7	12.2	293	292.6	15.3
54	53.9	02.8	114	113.8	06.0	174	173.8	09.1	234	233.7	12.2	294	293.6	15.4
55	54.9	02.9	115	114.8	06.0	175	174.8	09.2	235	234.7	12.3	295	294.6	15.4
56	55.9	02.9	116	115.8	06.1	176	175.8	09.2	236	235.7	12.4	296	295.6	15.5
57	56.9	03.0	117	116.8	06.1	177	176.8	09.3	237	236.7	12.4	297	296.6	15.5
58	57.9	03.0	118	117.8	06.2	178	177.8	09.3	238	237.7	12.5	298	297.6	15.6
59	58.9	03.1	119	118.8	06.2	179	178.8	09.4	239	238.7	12.5	299	298.6	15.6
60	59.9	03.1	120	119.8	06.3	180	179.8	09.4	240	239.7	12.6	300	299.6	15.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 87 Degrees.

TABLE II.

Difference of Latitude and Departure for 4 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.9	04.3	121	120.7	08.4	181	180.6	12.6	241	240.4	16.8
2	02.0	00.1	62	61.8	04.3	122	121.7	08.5	182	181.6	12.7	242	241.4	16.9
3	03.0	00.2	63	62.8	04.4	123	122.7	08.6	183	182.6	12.8	243	242.4	17.0
4	04.0	00.3	64	63.8	04.5	124	123.7	08.6	184	183.6	12.8	244	243.4	17.0
5	05.0	00.3	65	64.8	04.5	125	124.7	08.7	185	184.5	12.9	245	244.4	17.1
6	06.0	00.4	66	65.8	04.6	126	125.7	08.8	186	185.5	13.0	246	245.4	17.2
7	07.0	00.5	67	66.8	04.7	127	126.7	08.9	187	186.5	13.0	247	246.4	17.2
8	08.0	00.6	68	67.8	04.7	128	127.7	08.9	188	187.5	13.1	248	247.4	17.3
9	09.0	00.6	69	68.8	04.8	129	128.7	09.0	189	188.5	13.2	249	248.4	17.4
10	10.0	00.7	70	69.8	04.9	130	129.7	09.1	190	189.5	13.3	250	249.4	17.4
11	11.0	00.8	71	70.8	05.0	131	130.7	09.1	191	190.5	13.3	251	250.4	17.5
12	12.0	00.8	72	71.8	05.0	132	131.7	09.2	192	191.5	13.4	252	251.4	17.6
13	13.0	00.9	73	72.8	05.1	133	132.7	09.3	193	192.5	13.5	253	252.4	17.6
14	14.0	01.0	74	73.8	05.2	134	133.7	09.3	194	193.5	13.5	254	253.4	17.7
15	15.0	01.0	75	74.8	05.2	135	134.7	09.4	195	194.5	13.6	255	254.4	17.8
16	16.0	01.1	76	75.8	05.3	136	135.7	09.5	196	195.5	13.7	256	255.4	17.9
17	17.0	01.2	77	76.8	05.4	137	136.7	09.6	197	196.5	13.7	257	256.4	17.9
18	18.0	01.3	78	77.8	05.4	138	137.7	09.6	198	197.5	13.8	258	257.4	18.0
19	19.0	01.3	79	78.8	05.5	139	138.7	09.7	199	198.5	13.9	259	258.4	18.1
20	20.0	01.4	80	79.8	05.6	140	139.7	09.8	200	199.5	14.0	260	259.4	18.1
21	20.9	01.5	81	80.8	05.7	141	140.7	09.8	201	200.5	14.0	261	260.4	18.2
22	21.9	01.5	82	81.8	05.7	142	141.7	09.9	202	201.5	14.1	262	261.4	18.3
23	22.9	01.6	83	82.8	05.8	143	142.7	10.0	203	202.5	14.2	263	262.4	18.3
24	23.9	01.7	84	83.8	05.9	144	143.6	10.0	204	203.5	14.2	264	263.4	18.4
25	24.9	01.7	85	84.8	05.9	145	144.6	10.1	205	204.5	14.3	265	264.4	18.5
26	25.9	01.8	86	85.8	06.0	146	145.6	10.2	206	205.5	14.4	266	265.4	18.6
27	26.9	01.9	87	86.8	06.1	147	146.6	10.3	207	206.5	14.4	267	266.3	18.6
28	27.9	02.0	88	87.8	06.1	148	147.6	10.3	208	207.5	14.5	268	267.3	18.7
29	28.9	02.0	89	88.8	06.2	149	148.6	10.4	209	208.5	14.6	269	268.3	18.8
30	29.9	02.1	90	89.8	06.3	150	149.6	10.5	210	209.5	14.6	270	269.3	18.8
31	30.9	02.2	91	90.8	06.3	151	150.6	10.5	211	210.5	14.7	271	270.3	18.9
32	31.9	02.2	92	91.8	06.4	152	151.6	10.6	212	211.5	14.8	272	271.3	19.0
33	32.9	02.3	93	92.8	06.5	153	152.6	10.7	213	212.5	14.9	273	272.3	19.0
34	33.9	02.4	94	93.8	06.6	154	153.6	10.7	214	213.5	14.9	274	273.3	19.1
35	34.9	02.4	95	94.8	06.6	155	154.6	10.8	215	214.5	15.0	275	274.3	19.2
36	35.9	02.5	96	95.8	06.7	156	155.6	10.9	216	215.5	15.1	276	275.3	19.3
37	36.9	02.6	97	96.8	06.8	157	156.6	11.0	217	216.5	15.1	277	276.3	19.3
38	37.9	02.7	98	97.8	06.8	158	157.6	11.0	218	217.5	15.2	278	277.3	19.4
39	38.9	02.7	99	98.8	06.9	159	158.6	11.1	219	218.5	15.3	279	278.3	19.5
40	39.9	02.8	100	99.8	07.0	160	159.6	11.2	220	219.5	15.3	280	279.3	19.5
41	40.9	02.9	101	100.8	07.0	161	160.6	11.2	221	220.5	15.4	281	280.3	19.6
42	41.9	02.9	102	101.8	07.1	162	161.6	11.3	222	221.5	15.5	282	281.3	19.7
43	42.9	03.0	103	102.7	07.2	163	162.6	11.4	223	222.5	15.6	283	282.3	19.7
44	43.9	03.1	104	103.7	07.3	164	163.6	11.4	224	223.5	15.6	284	283.3	19.8
45	44.9	03.1	105	104.7	07.3	165	164.6	11.5	225	224.5	15.7	285	284.3	19.9
46	45.9	03.2	106	105.7	07.4	166	165.6	11.6	226	225.4	15.8	286	285.3	20.0
47	46.9	03.3	107	106.7	07.5	167	166.6	11.6	227	226.4	15.8	287	286.3	20.0
48	47.9	03.3	108	107.7	07.5	168	167.6	11.7	228	227.4	15.9	288	287.3	20.1
49	48.9	03.4	109	108.7	07.6	169	168.6	11.8	229	228.4	16.0	289	288.3	20.2
50	49.9	03.5	110	109.7	07.7	170	169.6	11.9	230	229.4	16.0	290	289.3	20.2
51	50.9	03.6	111	110.7	07.7	171	170.6	11.9	231	230.4	16.1	291	290.3	20.3
52	51.9	03.6	112	111.7	07.8	172	171.6	12.0	232	231.4	16.2	292	291.3	20.4
53	52.9	03.7	113	112.7	07.9	173	172.6	12.1	233	232.4	16.3	293	292.3	20.4
54	53.9	03.8	114	113.7	08.0	174	173.6	12.1	234	233.4	16.3	294	293.3	20.5
55	54.9	03.8	115	114.7	08.0	175	174.6	12.2	235	234.4	16.4	295	294.3	20.6
56	55.9	03.9	116	115.7	08.1	176	175.6	12.3	236	235.4	16.5	296	295.3	20.6
57	56.9	04.0	117	116.7	08.2	177	176.6	12.3	237	236.4	16.5	297	296.3	20.7
58	57.9	04.0	118	117.7	08.2	178	177.6	12.4	238	237.4	16.6	298	297.3	20.8
59	58.9	04.1	119	118.7	08.3	179	178.6	12.5	239	238.4	16.7	299	298.3	20.9
60	59.9	04.2	120	119.7	08.4	180	179.6	12.6	240	239.4	16.7	300	299.3	20.9
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 86 Degrees.

TABLE II.

Difference of Latitude and Departure for 5 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.8	05.3	121	120.5	10.5	181	180.3	15.8	241	240.1	21.0
2	02.0	00.2	62	61.8	05.4	122	121.5	10.6	182	181.3	15.9	242	241.1	21.1
3	03.0	00.3	63	62.8	05.5	123	122.5	10.7	183	182.3	15.9	243	242.1	21.2
4	04.0	00.3	64	63.8	05.6	124	123.5	10.8	184	183.3	16.0	244	243.1	21.3
5	05.0	00.4	65	64.8	05.7	125	124.5	10.9	185	184.3	16.1	245	244.1	21.4
6	06.0	00.5	66	65.7	05.8	126	125.5	11.0	186	185.3	16.2	246	245.1	21.4
7	07.0	00.6	67	66.7	05.8	127	126.5	11.1	187	186.3	16.3	247	246.1	21.5
8	08.0	00.7	68	67.7	05.9	128	127.5	11.2	188	187.3	16.4	248	247.1	21.6
9	09.0	00.8	69	68.7	06.0	129	128.5	11.2	189	188.3	16.5	249	248.1	21.7
10	10.0	00.9	70	69.7	06.1	130	129.5	11.3	190	189.3	16.6	250	249.0	21.8
11	11.0	01.0	71	70.7	06.2	131	130.5	11.4	191	190.3	16.6	251	250.0	21.9
12	12.0	01.0	72	71.7	06.3	132	131.5	11.5	192	191.3	16.7	252	251.0	22.0
13	13.0	01.1	73	72.7	06.4	133	132.5	11.6	193	192.3	16.8	253	252.0	22.1
14	13.9	01.2	74	73.7	06.4	134	133.5	11.7	194	193.3	16.9	254	253.0	22.1
15	14.9	01.3	75	74.7	06.5	135	134.5	11.8	195	194.3	17.0	255	254.0	22.2
16	15.9	01.4	76	75.7	06.6	136	135.5	11.9	196	195.3	17.1	256	255.0	22.3
17	16.9	01.5	77	76.7	06.7	137	136.5	11.9	197	196.3	17.2	257	256.0	22.4
18	17.9	01.6	78	77.7	06.8	138	137.5	12.0	198	197.2	17.3	258	257.0	22.5
19	18.9	01.7	79	78.7	06.9	139	138.5	12.1	199	198.2	17.3	259	258.0	22.6
20	19.9	01.7	80	79.7	07.0	140	139.5	12.2	200	199.2	17.4	260	259.0	22.7
21	20.9	01.8	81	80.7	07.1	141	140.5	12.3	201	200.2	17.5	261	260.0	22.7
22	21.9	01.9	82	81.7	07.1	142	141.5	12.4	202	201.2	17.6	262	261.0	22.8
23	22.9	02.0	83	82.7	07.2	143	142.5	12.5	203	202.2	17.7	263	262.0	22.9
24	23.9	02.1	84	83.7	07.3	144	143.5	12.6	204	203.2	17.8	264	263.0	23.0
25	24.9	02.2	85	84.7	07.4	145	144.4	12.6	205	204.2	17.9	265	264.0	23.1
26	25.9	02.3	86	85.7	07.5	146	145.4	12.7	206	205.2	18.0	266	265.0	23.2
27	26.9	02.4	87	86.7	07.6	147	146.4	12.8	207	206.2	18.0	267	266.0	23.3
28	27.9	02.4	88	87.7	07.7	148	147.4	12.9	208	207.2	18.1	268	267.0	23.4
29	28.9	02.5	89	88.7	07.8	149	148.4	13.0	209	208.2	18.2	269	268.0	23.4
30	29.9	02.6	90	89.7	07.8	150	149.4	13.1	210	209.2	18.3	270	269.0	23.5
31	30.9	02.7	91	90.7	07.9	151	150.4	13.2	211	210.2	18.4	271	270.0	23.6
32	31.9	02.8	92	91.6	08.0	152	151.4	13.2	212	211.2	18.5	272	271.0	23.7
33	32.9	02.9	93	92.6	08.1	153	152.4	13.3	213	212.2	18.6	273	272.0	23.8
34	33.9	03.0	94	93.6	08.2	154	153.4	13.4	214	213.2	18.7	274	273.0	23.9
35	34.9	03.1	95	94.6	08.3	155	154.4	13.5	215	214.2	18.7	275	274.0	24.0
36	35.9	03.1	96	95.6	08.4	156	155.4	13.6	216	215.2	18.8	276	274.9	24.1
37	36.9	03.2	97	96.6	08.5	157	156.4	13.7	217	216.2	18.9	277	275.9	24.1
38	37 9	03.3	98	97.6	08.5	158	157.4	13.8	218	217.2	19.0	278	276.9	24.2
39	38.9	03.4	99	98.6	08.6	159	158.4	13.9	219	218.2	19.1	279	277.9	24.3
40	39.8	03.5	100	99.6	08.7	160	159.4	13.9	220	219.2	19.2	280	278.9	24.4
41	40.8	03.6	101	100.6	08.8	161	160.4	14.0	221	220.2	19.3	281	279.9	24.5
42	41.8	03.7	102	101.6	08.9	162	161.4	14.1	222	221.2	19.3	282	280.9	24.6
43	42.8	03.7	103	102.6	09.0	163	162.4	14.2	223	222.2	19.4	283	281.9	24.7
44	43.8	03.8	104	103.6	09.1	164	163.4	14.3	224	223.1	19.5	284	282.9	24.8
45	44.8	03.9	105	104.6	09.2	165	164.4	14.4	225	224.1	19.6	285	283.9	24.8
46	45.8	04.0	106	105.6	09.2	166	165.4	14.5	226	225.1	19.7	286	284.9	24.9
47	46.8	04.1	107	106.6	09.3	167	166.4	14.6	227	226.1	19.8	287	285.9	25.0
48	47.8	04.2	108	107.6	09.4	168	167.4	14.6	228	227.1	19.9	288	286.9	25.1
49	48.8	04.3	109	108.6	09.5	169	168.4	14.7	229	228.1	20.0	289	287.9	25.2
50	49.8	04.4	110	109.6	09.6	170	169.4	14.8	230	229.1	20.0	290	288.9	25.3
51	50.8	04.4	111	110.6	09.7	171	170.3	14.9	231	230.1	20.1	291	289.9	25.4
52	51.8	04.5	112	111.6	09.8	172	171.3	15.0	232	231.1	20.2	292	290.9	25.4
53	52.8	04.6	113	112.6	09.8	173	172.3	15.1	233	232.1	20.3	293	291.9	25.5
54	53.8	04.7	114	113.6	09.9	174	173.3	15.2	234	233.1	20.4	294	292.9	25.6
55	54.8	04.8	115	114.6	10.0	175	174.3	15.3	235	234.1	20.5	295	293.9	25.7
56	55.8	04.9	116	115.6	10.1	176	175.3	15.3	236	235.1	20.6	296	294.9	25.8
57	56.8	05.0	117	116.6	10.2	177	176.3	15.4	237	236.1	20.7	297	295.9	25.9
58	57.8	05.1	118	117.6	10.3	178	177.3	15.5	238	237.1	20.7	298	296.9	26.0
59	58.8	05.1	119	118.5	10.4	179	178.3	15.6	239	238.1	20.8	299	297.9	26.1
60	59.8	05.2	120	119.5	10.5	180	179.3	15.7	240	239.1	20.9	300	298.9	26.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 85 Degrees.

TABLE II.

Difference of Latitude and Departure for 6 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.7	06.4	121	120.3	12.6	181	180.0	18.9	241	239.7	25.2
2	02.0	00.2	62	61.7	06.5	122	121.3	12.8	182	181.0	19.0	242	240.7	25.3
3	03.0	00.3	63	62.7	06.6	123	122.3	12.9	183	182.0	19.1	243	241.7	25.4
4	04.0	00.4	64	63.6	06.7	124	123.3	13.0	184	183.0	19.2	244	242.7	25.5
5	05.0	00.5	65	64.6	06.8	125	124.3	13.1	185	184.0	19.3	245	243.7	25.6
6	06.0	00.6	66	65.6	06.9	126	125.3	13.2	186	185.0	19.4	246	244.7	25.7
7	07.0	00.7	67	66.6	07.0	127	126.3	13.3	187	186.0	19.5	247	245.6	25.8
8	08.0	00.8	68	67.6	07.1	128	127.3	13.4	188	187.0	19.7	248	246.6	25.9
9	09.0	00.9	69	68.6	07.2	129	128.3	13.5	189	188.0	19.8	249	247.6	26.0
10	09.9	01.0	70	69.6	07.3	130	129.3	13.6	190	189.0	19.9	250	248.6	26.1
11	10.9	01.1	71	70.6	07.4	131	130.3	13.7	191	190.0	20.0	251	249.6	26.2
12	11.9	01.3	72	71.6	07.5	132	131.3	13.8	192	190.9	20.1	252	250.6	26.3
13	12.9	01.4	73	72.6	07.6	133	132.3	13.9	193	191.9	20.2	253	251.6	26.4
14	13.9	01.5	74	73.6	07.7	134	133.3	14.0	194	192.9	20.3	254	252.6	26.6
15	14.9	01.6	75	74.6	07.8	135	134.3	14.1	195	193.9	20.4	255	253.6	26.7
16	15.9	01.7	76	75.6	07.9	136	135.3	14.2	196	194.9	20.5	256	254.6	26.8
17	16.9	01.8	77	76.6	08.0	137	136.2	14.3	197	195.9	20.6	257	255.6	26.9
18	17.9	01.9	78	77.6	08.2	138	137.2	14.4	198	196.9	20.7	258	256.6	27.0
19	18.9	02.0	79	78.6	08.3	139	138.2	14.5	199	197.9	20.8	259	257.6	27.1
20	19.9	02.1	80	79.6	08.4	140	139.2	14.6	200	198.9	20.9	260	258.6	27.2
21	20.9	02.2	81	80.6	08.5	141	140.2	14.7	201	199.9	21.0	261	259.6	27.3
22	21.9	02.3	82	81.6	08.6	142	141.2	14.8	202	200.9	21.1	262	260.6	27.4
23	22.9	02.4	83	82.5	08.7	143	142.2	14.9	203	201.9	21.2	263	261.6	27.5
24	23.9	02.5	84	83.5	08.8	144	143.2	15.1	204	202.9	21.3	264	262.6	27.6
25	24.9	02.6	85	84.5	08.9	145	144.2	15.2	205	203.9	21.4	265	263.5	27.7
26	25.9	02.7	86	85.5	09.0	146	145.2	15.3	206	204.9	21.5	266	264.5	27.8
27	26.9	02.8	87	86.5	09.1	147	146.2	15.4	207	205.9	21.6	267	265.5	27.9
28	27.8	02.9	88	87.5	09.2	148	147.2	15.5	208	206.9	21.7	268	266.5	28.0
29	28.8	03.0	89	88.5	09.3	149	148.2	15.6	209	207.9	21.8	269	267.5	28.1
30	29.8	03.1	90	89.5	09.4	150	149.2	15.7	210	208.8	22.0	270	268.5	28.2
31	30.8	03.2	91	90.5	09.5	151	150.2	15.8	211	209.8	22.1	271	269.5	28.3
32	31.8	03.3	92	91.5	09.6	152	151.2	15.9	212	210.8	22.2	272	270.5	28.4
33	32.8	03.4	93	92.5	09.7	153	152.2	16.0	213	211.8	22.3	273	271.5	28.5
34	33.8	03.6	94	93.5	09.8	154	153.2	16.1	214	212.8	22.4	274	272.5	28.6
35	34.8	03.7	95	94.5	09.9	155	154.2	16.2	215	213.8	22.5	275	273.5	28.7
36	35.8	03.8	96	95.5	10.0	156	155.1	16.3	216	214.8	22.6	276	274.5	28.8
37	36.8	03.9	97	96.5	10.1	157	156.1	16.4	217	215.8	22.7	277	275.5	29.0
38	37.8	04.0	98	97.5	10.2	158	157.1	16.5	218	216.8	22.8	278	276.5	29.1
39	38.8	04.1	99	98.5	10.3	159	158.1	16.6	219	217.8	22.9	279	277.5	29.2
40	39.8	04.2	100	99.5	10.5	160	159.1	16.7	220	218.8	23.0	280	278.5	29.3
41	40.8	04.3	101	100.4	10.6	161	160.1	16.8	221	219.8	23.1	281	279.5	29.4
42	41.8	04.4	102	101.4	10.7	162	161.1	16.9	222	220.8	23.2	282	280.5	29.5
43	42.8	04.5	103	102.4	10.8	163	162.1	17.0	223	221.8	23.3	283	281.4	29.6
44	43.8	04.6	104	103.4	10.9	164	163.1	17.1	224	222.8	23.4	284	282.4	29.7
45	44.8	04.7	105	104.4	11.0	165	164.1	17.2	225	223.8	23.5	285	283.4	29.8
46	45.7	04.8	106	105.4	11.1	166	165.1	17.4	226	224.8	23.6	286	284.4	29.9
47	46.7	04.9	107	106.4	11.2	167	166.1	17.5	227	225.8	23.7	287	285.4	30.0
48	47.7	05.0	108	107.4	11.3	168	167.1	17.6	228	226.8	23.8	288	286.4	30.1
49	48.7	05.1	109	108.4	11.4	169	168.1	17.7	229	227.7	23.9	289	287.4	30.2
50	49.7	05.2	110	109.4	11.5	170	169.1	17.8	230	228.7	24.0	290	288.4	30.3
51	50.7	05.3	111	110.4	11.6	171	170.1	17.9	231	229.7	24.1	291	289.4	30.4
52	51.7	05.4	112	111.4	11.7	172	171.1	18.0	232	230.7	24.3	292	290.4	30.5
53	52.7	05.5	113	112.4	11.8	173	172.1	18.1	233	231.7	24.4	293	291.4	30.6
54	53.7	05.6	114	113.4	11.9	174	173.0	18.2	234	232.7	24.5	294	292.4	30.7
55	54.7	05.7	115	114.4	12.0	175	174.0	18.3	235	233.7	24.6	295	293.4	30.8
56	55.7	05.9	116	115.4	12.1	176	175.0	18.4	236	234.7	24.7	296	294.4	30.9
57	56.7	06.0	117	116.4	12.2	177	176.0	18.5	237	235.7	24.8	297	295.4	31.0
58	57.7	06.1	118	117.4	12.3	178	177.0	18.6	238	236.7	24.9	298	296.4	31.1
59	58.7	06.2	119	118.3	12.4	179	178.0	18.7	239	237.7	25.0	299	297.4	31.3
60	59.7	06.3	120	119.3	12.5	180	179.0	18.8	240	238.7	25.1	300	298.4	31.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 84 Degrees.

TABLE II.

Difference of Latitude and Departure for 7 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.5	07.4	121	120.1	14.7	181	179.7	22.1	241	239.2	29.4
2	02.0	00.2	62	61.5	07.6	122	121.1	14.9	182	180.6	22.2	242	240.2	29.5
3	03.0	00.4	63	62.5	07.7	123	122.1	15.0	183	181.6	22.3	243	241.2	29.6
4	04.0	00.5	64	63.5	07.8	124	123.1	15.1	184	182.6	22.4	244	242.2	29.7
5	05.0	00.6	65	64.5	07.9	125	124.1	15.2	185	183.6	22.5	245	243.2	29.9
6	06.0	00.7	66	65.5	08.0	126	125.1	15.4	186	184.6	22.7	246	244.2	30.0
7	06.9	00.9	67	66.5	08.2	127	126.1	15.5	187	185.6	22.8	247	245.2	30.1
8	07.9	01.0	68	67.5	08.3	128	127.0	15.6	188	186.6	22.9	248	246.2	30.2
9	08.9	01.1	69	68.5	08.4	129	128.0	15.7	189	187.6	23.0	249	247.1	30.3
10	09.9	01.2	70	69.5	08.5	130	129.0	15.8	190	188.6	23.2	250	248.1	30.5
11	10.9	01.3	71	70.5	08.7	131	130.0	16.0	191	189.6	23.3	251	249.1	30.6
12	11.9	01.5	72	71.5	08.8	132	131.0	16.1	192	190.6	23.4	252	250.1	30.7
13	12.9	01.6	73	72.5	08.9	133	132.0	16.2	193	191.6	23.5	253	251.1	30.8
14	13.9	01.7	74	73.4	09.0	134	133.0	16.3	194	192.6	23.6	254	252.1	31.0
15	14.9	01.8	75	74.4	09.1	135	134.0	16.5	195	193.5	23.8	255	253.1	31.1
16	15.9	01.9	76	75.4	09.3	136	135.0	16.6	196	194.5	23.9	256	254.1	31.2
17	16.9	02.1	77	76.4	09.4	137	136.0	16.7	197	195.5	24.0	257	255.1	31.3
18	17.9	02.2	78	77.4	09.5	138	137.0	16.8	198	196.5	24.1	258	256.1	31.4
19	18.9	02.3	79	78.4	09.6	139	138.0	16.9	199	197.5	24.3	259	257.1	31.6
20	19.9	02.4	80	79.4	09.7	140	139.0	17.1	200	198.5	24.4	260	258.1	31.7
21	20.8	02.6	81	80.4	09.9	141	139.9	17.2	201	199.5	24.5	261	259.1	31.8
22	21.8	02.7	82	81.4	10.0	142	140.9	17.3	202	200.5	24.6	262	260.0	31.9
23	22.8	02.8	83	82.4	10.1	143	141.9	17.4	203	201.5	24.7	263	261.0	32.1
24	23.8	02.9	84	83.4	10.2	144	142.9	17.5	204	202.5	24.9	264	262.0	32.2
25	24.8	03.0	85	84.4	10.4	145	143.9	17.7	205	203.5	25.0	265	263.0	32.3
26	25.8	03.2	86	85.4	10.5	146	144.9	17.8	206	204.5	25.1	266	264.0	32.4
27	26.8	03.3	87	86.4	10.6	147	145.9	17.9	207	205.5	25.2	267	265.0	32.5
28	27.8	03.4	88	87.3	10.7	148	146.9	18.0	208	206.4	25.3	268	266.0	32.7
29	28.8	03.5	89	88.3	10.8	149	147.9	18.2	209	207.4	25.5	269	267.0	32.8
30	29.8	03.7	90	89.3	11.0	150	148.9	18.3	210	208.4	25.6	270	268.0	32.9
31	30.8	03.8	91	90.3	11.1	151	149.9	18.4	211	209.4	25.7	271	269.0	33.0
32	31.8	03.9	92	91.3	11.2	152	150.9	18.5	212	210.4	25.8	272	270.0	33.1
33	32.8	04.0	93	92.3	11.3	153	151.9	18.6	213	211.4	26.0	273	271.0	33.3
34	33.7	04.1	94	93.3	11.5	154	152.9	18.8	214	212.4	26.1	274	272.0	33.4
35	34.7	04.3	95	94.3	11.6	155	153.8	18.9	215	213.4	26.2	275	273.0	33.5
36	35.7	04.4	96	95.3	11.7	156	154.8	19.0	216	214.4	26.3	276	273.9	33.6
37	36.7	04.5	97	96.3	11.8	157	155.8	19.1	217	215.4	26.4	277	274.9	33.8
38	37.7	04.6	98	97.3	11.9	158	156.8	19.3	218	216.4	26.6	278	275.9	33.9
39	38.7	04.8	99	98.3	12.1	159	157.8	19.4	219	217.4	26.7	279	276.9	34.0
40	39.7	04.9	100	99.3	12.2	160	158.8	19.5	220	218.4	26.8	280	277.9	34.1
41	40.7	05.0	101	100.2	12.3	161	159.8	19.6	221	219.4	26.9	281	278.9	34.2
42	41.7	05.1	102	101.2	12.4	162	160.8	19.7	222	220.3	27.1	282	279.9	34.4
43	42.7	05.2	103	102.2	12.6	163	161.8	19.9	223	221.3	27.2	283	280.9	34.5
44	43.7	05.4	104	103.2	12.7	164	162.8	20.0	224	222.3	27.3	284	281.9	34.6
45	44.7	05.5	105	104.2	12.8	165	163.8	20.1	225	223.3	27.4	285	282.9	34.7
46	45.7	05.6	106	105.2	12.9	166	164.8	20.2	226	224.3	27.5	286	283.9	34.9
47	46.6	05.7	107	106.2	13.0	167	165.8	20.4	227	225.3	27.7	287	284.9	35.0
48	47.6	05.8	108	107.2	13.2	168	166.7	20.5	228	226.3	27.8	288	285.9	35.1
49	48.6	06.0	109	108.2	13.3	169	167.7	20.6	229	227.3	27.9	289	286.8	35.2
50	49.6	06.1	110	109.2	13.4	170	168.7	20.7	230	228.3	28.0	290	287.8	35.3
51	50.6	06.2	111	110.2	13.5	171	169.7	20.8	231	229.3	28.2	291	288.8	35.5
52	51.6	06.3	112	111.2	13.6	172	170.7	21.0	232	230.3	28.3	292	289.8	35.6
53	52.6	06.5	113	112.2	13.8	173	171.7	21.1	233	231.3	28.4	293	290.8	35.7
54	53.6	06.6	114	113.2	13.9	174	172.7	21.2	234	232.3	28.5	294	291.8	35.8
55	54.6	06.7	115	114.1	14.0	175	173.7	21.3	235	233.2	28.6	295	292.8	36.0
56	55.6	06.8	116	115.1	14.1	176	174.7	21.4	236	234.2	28.8	296	293.8	36.1
57	56.6	06.9	117	116.1	14.3	177	175.7	21.6	237	235.2	28.9	297	294.8	36.2
58	57.6	07.1	118	117.1	14.4	178	176.7	21.7	238	236.2	29.0	298	295.8	36.3
59	58.6	07.2	119	118.1	14.5	179	177.7	21.8	239	237.2	29.1	299	296.8	36.4
60	59.6	07.3	120	119.1	14.6	180	178.7	21.9	240	238.2	29.2	300	297.8	36.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 83 Degrees.

TABLE II.

Difference of Latitude and Departure for 8 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.4	08.5	121	119.8	16.8	181	179.2	25.2	241	238.7	33.5
2	02.0	00.3	62	61.4	08.6	122	120.8	17.0	182	180.2	25.3	242	239.6	33.7
3	03.0	00.4	63	62.4	08.8	123	121.8	17.1	183	181.2	25.5	243	240.6	33.8
4	04.0	00.6	64	63.4	08.9	124	122.8	17.3	184	182.2	25.6	244	241.6	34.0
5	05.0	00.7	65	64.4	09.0	125	123.8	17.4	185	183.2	25.7	245	242.6	34.1
6	05.9	00.8	66	65.4	09.2	126	124.8	17.5	186	184.2	25.9	246	243.6	34.2
7	06.9	01.0	67	66.3	09.3	127	125.8	17.7	187	185.2	26.0	247	244.6	34.4
8	07.9	01.1	68	67.3	09.5	128	126.8	17.8	188	186.2	26.2	248	245.6	34.5
9	08.9	01.3	69	68.3	09.6	129	127.7	18.0	189	187.2	26.3	249	246.6	34.7
10	09.9	01.4	70	69.3	09.7	130	128.7	18.1	190	188.2	26.4	250	247.6	34.8
11	10.9	01.5	71	70.3	09.9	131	129.7	18.2	191	189.1	26.6	251	248.6	34.9
12	11.9	01.7	72	71.3	10.0	132	130.7	18.4	192	190.1	26.7	252	249.5	35.1
13	12.9	01.8	73	72.3	10.2	133	131.7	18.5	193	191.1	26.9	253	250.5	35.2
14	13.9	01.9	74	73.3	10.3	134	132.7	18.6	194	192.1	27.0	254	251.5	35.3
15	14.9	02.1	75	74.3	10.4	135	133.7	18.8	195	193.1	27.1	255	252.5	35.5
16	15.8	02.2	76	75.3	10.6	136	134.7	18.9	196	194.1	27.3	256	253.5	35.6
17	16.8	02.4	77	76.3	10.7	137	135.7	19.1	197	195.1	27.4	257	254.5	35.8
18	17.8	02.5	78	77.2	10.9	138	136.7	19.2	198	196.1	27.6	258	255.5	35.9
19	18.8	02.6	79	78.2	11.0	139	137.7	19.3	199	197.1	27.7	259	256.5	36.0
20	19.8	02.8	80	79.2	11.1	140	138.6	19.5	200	198.1	27.8	260	257.5	36.2
21	20.8	02.9	81	80.2	11.3	141	139.6	19.6	201	199.0	28.0	261	258.5	36.3
22	21.8	03.1	82	81.2	11.4	142	140.6	19.8	202	200.0	28.1	262	259.5	36.5
23	22.8	03.2	83	82.2	11.6	143	141.6	19.9	203	201.0	28.3	263	260.4	36.6
24	23.8	03.3	84	83.2	11.7	144	142.6	20.0	204	202.0	28.4	264	261.4	36.7
25	24.8	03.5	85	84.2	11.8	145	143.6	20.2	205	203.0	28.5	265	262.4	36.9
26	25.7	03.6	86	85.2	12.0	146	144.6	20.3	206	204.0	28.7	266	263.4	37.0
27	26.7	03.8	87	86.2	12.1	147	145.6	20.5	207	205.0	28.8	267	264.4	37.2
28	27.7	03.9	88	87.1	12.2	148	146.6	20.6	208	206.0	28.9	268	265.4	37.3
29	28.7	04.0	89	88.1	12.4	149	147.5	20.7	209	207.0	29.1	269	266.4	37.4
30	29.7	04.2	90	89.1	12.5	150	148.5	20.9	210	208.0	29.2	270	267.4	37.6
31	30.7	04.3	91	90.1	12.7	151	149.5	21.0	211	208.9	29.4	271	268.4	37.7
32	31.7	04.5	92	91.1	12.8	152	150.5	21.2	212	209.9	29.5	272	269.4	37.9
33	32.7	04.6	93	92.1	12.9	153	151.5	21.3	213	210.9	29.6	273	270.3	38.0
34	33.7	04.7	94	93.1	13.1	154	152.5	21.4	214	211.9	29.8	274	271.3	38.1
35	34.7	04.9	95	94.1	13.2	155	153.5	21.6	215	212.9	29.9	275	272.3	38.3
36	35.6	05.0	96	95.1	13.4	156	154.5	21.7	216	213.9	30.1	276	273.3	38.4
37	36.6	05.1	97	96.1	13.5	157	155.5	21.9	217	214.9	30.2	277	274.3	38.6
38	37.6	05.3	98	97.0	13.6	158	156.5	22.0	218	215.9	30.3	278	275.3	38.7
39	38.6	05.4	99	98.0	13.8	159	157.5	22.1	219	216.9	30.5	279	276.3	38.8
40	39.6	05.6	100	99.0	13.9	160	158.4	22.3	220	217.9	30.6	280	277.3	39.0
41	40.6	05.7	101	100.0	14.1	161	159.4	22.4	221	218.8	30.8	281	278.3	39.1
42	41.6	05.8	102	101.0	14.2	162	160.4	22.5	222	219.8	30.9	282	279.3	39.2
43	42.6	06.0	103	102.0	14.3	163	161.4	22.7	223	220.8	31.0	283	280.2	39.4
44	43.6	06.1	104	103.0	14.5	164	162.4	22.8	224	221.8	31.2	284	281.2	39.5
45	44.6	06.3	105	104.0	14.6	165	163.4	23.0	225	222.8	31.3	285	282.2	39.7
46	45.6	06.4	106	105.0	14.8	166	164.4	23.1	226	223.8	31.5	286	283.2	39.8
47	46.5	06.5	107	106.0	14.9	167	165.4	23.2	227	224.8	31.6	287	284.2	39.9
48	47.5	06.7	108	106.9	15.0	168	166.4	23.4	228	225.8	31.7	288	285.2	40.1
49	48.5	06.8	109	107.9	15.2	169	167.4	23.5	229	226.8	31.9	289	286.2	40.2
50	49.5	07.0	110	108.9	15.3	170	168.3	23.7	230	227.8	32.0	290	287.2	40.4
51	50.5	07.1	111	109.9	15.4	171	169.3	23.8	231	228.8	32.1	291	288.2	40.5
52	51.5	07.2	112	110.9	15.6	172	170.3	23.9	232	229.7	32.3	292	289.2	40.6
53	52.5	07.4	113	111.9	15.7	173	171.3	24.1	233	230.7	32.4	293	290.1	40.8
54	53.5	07.5	114	112.9	15.9	174	172.3	24.2	234	231.7	32.6	294	291.1	40.9
55	54.5	07.7	115	113.9	16.0	175	173.3	24.4	235	232.7	32.7	295	292.1	41.1
56	55.5	07.8	116	114.9	16.1	176	174.3	24.5	236	233.7	32.8	296	293.1	41.2
57	56.4	07.9	117	115.9	16.3	177	175.3	24.6	237	234.7	33.0	297	294.1	41.3
58	57.4	08.1	118	116.9	16.4	178	176.3	24.8	238	235.7	33.1	298	295.1	41.5
59	58.4	08.2	119	117.8	16.6	179	177.3	24.9	239	236.7	33.3	299	296.1	41.6
60	59.4	08.4	120	118.8	16.7	180	178.2	25.1	240	237.7	33.4	300	297.1	41.8
Dist	Dep.	Lat	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 82 Degrees.

TABLE II.

Difference of Latitude and Departure for 9 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	60.2	09.5	121	119.5	18.9	181	178.8	28.3	241	238.0	37.7
2	02.0	00.3	62	61.2	09.7	122	120.5	19.1	182	179.8	28.5	242	239.0	37.9
3	03.0	00.5	63	62.2	09.9	123	121.5	19.2	183	180.7	28.6	243	240.0	38.0
4	04.0	00.6	64	63.2	10.0	124	122.5	19.4	184	181.7	28.8	244	241.0	38.2
5	04.9	00.8	65	64.2	10.2	125	123.5	19.6	185	182.7	28.9	245	242.0	38.3
6	05.9	00.9	66	65.2	10.3	126	124.4	19.7	186	183.7	29.1	246	243.0	38.5
7	06.9	01.1	67	66.2	10.5	127	125.4	19.9	187	184.7	29.3	247	244.0	38.6
8	07.9	01.3	68	67.2	10.6	128	126.4	20.0	188	185.7	29.4	248	244.9	38.8
9	08.9	01.4	69	68.2	10.8	129	127.4	20.2	189	186.7	29.6	249	245.9	39.0
10	09.9	01.6	70	69.1	11.0	130	128.4	20.3	190	187.7	29.7	250	246.9	39.1
11	10.9	01.7	71	70.1	11.1	131	129.4	20.5	191	188.6	29.9	251	247.9	39.3
12	11.9	01.9	72	71.1	11.3	132	130.4	20.6	192	189.6	30.0	252	248.9	39.4
13	12.8	02.0	73	72.1	11.4	133	131.4	20.8	193	190.6	30.2	253	249.9	39.6
14	13.8	02.2	74	73.1	11.6	134	132.4	21.0	194	191.6	30.3	254	250.9	39.7
15	14.8	02.3	75	74.1	11.7	135	133.3	21.1	195	192.6	30.5	255	251.9	39.9
16	15.8	02.5	76	75.1	11.9	136	134.3	21.3	196	193.6	30.7	256	252.8	40.0
17	16.8	02.7	77	76.1	12.0	137	135.3	21.4	197	194.6	30.8	257	253.8	40.2
18	17.8	02.8	78	77.0	12.2	138	136.3	21.6	198	195.6	31.0	258	254.8	40.4
19	18.8	03.0	79	78.0	12.4	139	137.3	21.7	199	196.5	31.1	259	255.8	40.5
20	19.8	03.1	80	79.0	12.5	140	138.3	21.9	200	197.5	31.3	260	256.8	40.7
21	20.7	03.3	81	80.0	12.7	141	139.3	22.1	201	198.5	31.4	261	257.8	40.8
22	21.7	03.4	82	81.0	12.8	142	140.3	22.2	202	199.5	31.6	262	258.8	41.0
23	22.7	03.6	83	82.0	13.0	143	141.2	22.4	203	200.5	31.8	263	259.8	41.1
24	23.7	03.8	84	83.0	13.1	144	142.2	22.5	204	201.5	31.9	264	260.7	41.3
25	24.7	03.9	85	84.0	13.3	145	143.2	22.7	205	202.5	32.1	265	261.7	41.5
26	25.7	04.1	86	84.9	13.5	146	144.2	22.8	206	203.5	32.2	266	262.7	41.6
27	26.7	04.2	87	85.9	13.6	147	145.2	23.0	207	204.5	32.4	267	263.7	41.8
28	27.7	04.4	88	86.9	13.8	148	146.2	23.2	208	205.4	32.5	268	264.7	41.9
29	28.6	04.5	89	87.9	13.9	149	147.2	23.3	209	206.4	32.7	269	265.7	42.1
30	29.6	04.7	90	88.9	14.1	150	148.2	23.5	210	207.4	32.9	270	266.7	42.2
31	30.6	04.8	91	89.9	14.2	151	149.1	23.6	211	208.4	33.0	271	267.7	42.4
32	31.6	05.0	92	90.9	14.4	152	150.1	23.8	212	209.4	33.2	272	268.7	42.6
33	32.6	05.2	93	91.9	14.5	153	151.1	23.9	213	210.4	33.3	273	269.6	42.7
34	33.6	05.3	94	92.8	14.7	154	152.1	24.1	214	211.4	33.5	274	270.6	42.9
35	34.6	05.5	95	93.8	14.9	155	153.1	24.2	215	212.4	33.6	275	271.6	43.0
36	35.6	05.6	96	94.8	15.0	156	154.1	24.4	216	213.3	33.8	276	272.6	43.2
37	36.5	05.8	97	95.8	15.2	157	155.1	24.6	217	214.3	33.9	277	273.6	43.3
38	37.5	05.9	98	96.8	15.3	158	156.1	24.7	218	215.3	34.1	278	274.6	43.5
39	38.5	06.1	99	97.8	15.5	159	157.0	24.9	219	216.3	34.3	279	275.6	43.6
40	39.5	06.3	100	98.8	15.6	160	158.0	25.0	220	217.3	34.4	280	276.6	43.8
41	40.5	06.4	101	99.8	15.8	161	159.0	25.2	221	218.3	34.6	281	277.5	44.0
42	41.5	06.6	102	100.7	16.0	162	160.0	25.3	222	219.3	34.7	282	278.5	44.1
43	42.5	06.7	103	101.7	16.1	163	161.0	25.5	223	220.3	34.9	283	279.5	44.3
44	43.5	06.9	104	102.7	16.3	164	162.0	25.7	224	221.2	35.0	284	280.5	44.4
45	44.4	07.0	105	103.7	16.4	165	163.0	25.8	225	222.2	35.2	285	281.5	44.6
46	45.4	07.2	106	104.7	16.6	166	164.0	26.0	226	223.2	35.4	286	282.5	44.7
47	46.4	07.4	107	105.7	16.7	167	164.9	26.1	227	224.2	35.5	287	283.5	44.9
48	47.4	07.5	108	106.7	16.9	168	165.9	26.3	228	225.2	35.7	288	284.5	45.1
49	48.4	07.7	109	107.7	17.1	169	166.9	26.4	229	226.2	35.8	289	285.4	45.2
50	49.4	07.8	110	108.6	17.2	170	167.9	26.6	230	227.2	36.0	290	286.4	45.4
51	50.4	08.0	111	109.6	17.4	171	168.9	26.8	231	228.2	36.1	291	287.4	45.5
52	51.4	08.1	112	110.6	17.5	172	169.9	26.9	232	229.1	36.3	292	288.4	45.7
53	52.3	08.3	113	111.6	17.7	173	170.9	27.1	233	230.1	36.4	293	289.4	45.8
54	53.3	08.4	114	112.6	17.8	174	171.9	27.2	234	231.1	36.6	294	290.4	46.0
55	54.3	08.6	115	113.6	18.0	175	172.8	27.4	235	232.1	36.8	295	291.4	46.1
56	55.3	08.8	116	114.6	18.1	176	173.8	27.5	236	233.1	36.9	296	292.4	46.3
57	56.3	08.9	117	115.6	18.3	177	174.8	27.7	237	234.1	37.1	297	293.3	46.5
58	57.3	09.1	118	116.5	18.5	178	175.8	27.8	238	235.1	37.2	298	294.3	46.6
59	58.3	09.2	119	117.5	18.6	179	176.8	28.0	239	236.1	37.4	299	295.3	46.8
60	59.3	09.4	120	118.5	18.8	180	177.8	28.2	240	237.0	37.5	300	296.3	46.9
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 81 Degrees.

TABLE II.

Difference of Latitude and Departure for 10 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	60.1	10.6	121	119.2	21.0	181	178.3	31.4	241	237.3	41.8
2	02.0	00.3	62	61.1	10.8	122	120.1	21.2	182	179.2	31.6	242	238.3	42.0
3	03.0	00.5	63	62.0	10.9	123	121.1	21.4	183	180.2	31.8	243	239.3	42.2
4	03.9	00.7	64	63.0	11.1	124	122.1	21.5	184	181.2	32.0	244	240.3	42.4
5	04.9	00.9	65	64.0	11.3	125	123.1	21.7	185	182.2	32.1	245	241.3	42.5
6	05.9	01.0	66	65.0	11.5	126	124.1	21.9	186	183.2	32.3	246	242.3	42.7
7	06.9	01.2	67	66.0	11.6	127	125.1	22.1	187	184.2	32.5	247	243.2	42.9
8	07.9	01.4	68	67.0	11.8	128	126.1	22.2	188	185.1	32.6	248	244.2	43.1
9	08.9	01.6	69	68.0	12.0	129	127.0	22.4	189	186.1	32.8	249	245.2	43.2
10	09.8	01.7	70	68.9	12.2	130	128.0	22.6	190	187.1	33.0	250	246.2	43.4
11	10.8	01.9	71	69.9	12.3	131	129.0	22.7	191	188.1	33.2	251	247.2	43.6
12	11.8	02.1	72	70.9	12.5	132	130.0	22.9	192	189.1	33.3	252	248.2	43.8
13	12.8	02.3	73	71.9	12.7	133	131.0	23.1	193	190.1	33.5	253	249.2	43.9
14	13.8	02.4	74	72.9	12.8	134	132.0	23.3	194	191.1	33.7	254	250.1	44.1
15	14.8	02.6	75	73.9	13.0	135	132.9	23.4	195	192.0	33.9	255	251.1	44.3
16	15.8	02.8	76	74.8	13.2	136	133.9	23.6	196	193.0	34.0	256	252.1	44.5
17	16.7	03.0	77	75.8	13.4	137	134.9	23.8	197	194.0	34.2	257	253.1	44.6
18	17.7	03.1	78	76.8	13.5	138	135.9	24.0	198	195.0	34.4	258	254.1	44.8
19	18.7	03.3	79	77.8	13.7	139	136.9	24.1	199	196.0	34.6	259	255.1	45.0
20	19.7	03.5	80	78.8	13.9	140	137.9	24.3	200	197.0	34.7	260	256.1	45.1
21	20.7	03.6	81	79.8	14.1	141	138.9	24.5	201	197.9	34.9	261	257.0	45.3
22	21.7	03.8	82	80.8	14.2	142	139.8	24.7	202	198.9	35.1	262	258.0	45.5
23	22.7	04.0	83	81.7	14.4	143	140.8	24.8	203	199.9	35.3	263	259.0	45.7
24	23.6	04.2	84	82.7	14.6	144	141.8	25.0	204	200.9	35.4	264	260.0	45.8
25	24.6	04.3	85	83.7	14.8	145	142.8	25.2	205	201.9	35.6	265	261.0	46.0
26	25.6	04.5	86	84.7	14.9	146	143.8	25.4	206	202.9	35.8	266	262.0	46.2
27	26.6	04.7	87	85.7	15.1	147	144.8	25.5	207	203.9	35.9	267	262.9	46.4
28	27.6	04.9	88	86.7	15.3	148	145.8	25.7	208	204.8	36.1	268	263.9	46.5
29	28.6	05.0	89	87.6	15.5	149	146.7	25.9	209	205.8	36.3	269	264.9	46.7
30	29.5	05.2	90	88.6	15.6	150	147.7	26.0	210	206.8	36.5	270	265.9	46.9
31	30.5	05.4	91	89.6	15.8	151	148.7	26.2	211	207.8	36.6	271	266.9	47.1
32	31.5	05.6	92	90.6	16.0	152	149.7	26.4	212	208.8	36.8	272	267.9	47.2
33	32.5	05.7	93	91.6	16.1	153	150.7	26.6	213	209.8	37.0	273	268.9	47.4
34	33.5	05.9	94	92.6	16.3	154	151.7	26.7	214	210.7	37.2	274	269.8	47.6
35	34.5	06.1	95	93.6	16.5	155	152.6	26.9	215	211.7	37.3	275	270.8	47.8
36	35.5	06.3	96	94.5	16.7	156	153.6	27.1	216	212.7	37.5	276	271.8	47.9
37	36.4	06.4	97	95.5	16.8	157	154.6	27.3	217	213.7	37.7	277	272.8	48.1
38	37.4	06.6	98	96.5	17.0	158	155.6	27.4	218	214.7	37.9	278	273.8	48.3
39	38.4	06.8	99	97.5	17.2	159	156.6	27.6	219	215.7	38.0	279	274.8	48.4
40	39.4	06.9	100	98.5	17.4	160	157.6	27.8	220	216.7	38.2	280	275.7	48.6
41	40.4	07.1	101	99.5	17.5	161	158.6	28.0	221	217.6	38.4	281	276.7	48.8
42	41.4	07.3	102	100.5	17.7	162	159.5	28.1	222	218.6	38.5	282	277.7	49.0
43	42.3	07.5	103	101.4	17.9	163	160.5	28.3	223	219.6	38.7	283	278.7	49.1
44	43.3	07.6	104	102.4	18.1	164	161.5	28.5	224	220.6	38.9	284	279.7	49.3
45	44.3	07.8	105	103.4	18.2	165	162.5	28.7	225	221.6	39.1	285	280.7	49.5
46	45.3	08.0	106	104.4	18.4	166	163.5	28.8	226	222.6	39.2	286	281.7	49.7
47	46.3	08.2	107	105.4	18.6	167	164.5	29.0	227	223.6	39.4	287	282.6	49.8
48	47.3	08.3	108	106.4	18.8	168	165.4	29.2	228	224.5	39.6	288	283.6	50.0
49	48.3	08.5	109	107.3	18.9	169	166.4	29.3	229	225.5	39.8	289	284.6	50.2
50	49.2	08.7	110	108.3	19.1	170	167.4	29.5	230	226.5	39.9	290	285.6	50.4
51	50.2	08.9	111	109.3	19.3	171	168.4	29.7	231	227.5	40.1	291	286.6	50.5
52	51.2	09.0	112	110.3	19.4	172	169.4	29.9	232	228.5	40.3	292	287.6	50.7
53	52.2	09.2	113	111.3	19.6	173	170.4	30.0	233	229.5	40.5	293	288.5	50.9
54	53.2	09.4	114	112.3	19.8	174	171.4	30.2	234	230.4	40.6	294	289.5	51.1
55	54.2	09.6	115	113.3	20.0	175	172.3	30.4	235	231.4	40.8	295	290.5	51.2
56	55.1	09.7	116	114.2	20.1	176	173.3	30.6	236	232.4	41.0	296	291.5	51.4
57	56.1	09.9	117	115.2	20.3	177	174.3	30.7	237	233.4	41.2	297	292.5	51.6
58	57.1	10.1	118	116.2	20.5	178	175.3	30.9	238	234.4	41.3	298	293.5	51.7
59	58.1	10.2	119	117.2	20.7	179	176.3	31.1	239	235.4	41.5	299	294.5	51.9
60	59.1	10.4	120	118.2	20.8	180	177.3	31.3	240	236.4	41.7	300	295.4	52.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 80 Degrees.

TABLE II.

Difference of Latitude and Departure for 11 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.9	11.6	121	118.8	23.1	181	177.7	34.5	241	236.6	46.0
2	02.0	00.4	62	60.9	11.8	122	119.8	23.3	182	178.7	34.7	242	237.6	46.2
3	02.9	00.6	63	61.8	12.0	123	120.7	23.5	183	179.6	34.9	243	238.5	46.4
4	03.9	00.8	64	62.8	12.2	124	121.7	23.7	184	180.6	35.1	244	239.5	46.6
5	04.9	01.0	65	63.8	12.4	125	122.7	23.9	185	181.6	35.3	245	240.5	46.7
6	05.9	01.1	66	64.8	12.6	126	123.7	24.0	186	182.6	35.5	246	241.5	46.9
7	06.9	01.3	67	65.8	12.8	127	124.7	24.2	187	183.6	35.7	247	242.5	47.1
8	07.9	01.5	68	66.8	13.0	128	125.6	24.4	188	184.5	35.9	248	243.4	47.3
9	08.8	01.7	69	67.7	13.2	129	126.6	24.6	189	185.5	36.1	249	244.4	47.5
10	09.8	01.9	70	68.7	13.4	130	127.6	24.8	190	186.5	36.3	250	245.4	47.7
11	10.8	02.1	71	69.7	13.5	131	128.6	25.0	191	187.5	36.4	251	246.4	47.9
12	11.8	02.3	72	70.7	13.7	132	129.6	25.2	192	188.5	36.6	252	247.4	48.1
13	12.8	02.5	73	71.7	13.9	133	130.6	25.4	193	189.5	36.8	253	248.4	48.3
14	13.7	02.7	74	72.6	14.1	134	131.5	25.6	194	190.4	37.0	254	249.3	48.5
15	14.7	02.9	75	73.6	14.3	135	132.5	25.8	195	191.4	37.2	255	250.3	48.7
16	15.7	03.1	76	74.6	14.5	136	133.5	26.0	196	192.4	37.4	256	251.3	48.8
17	16.7	03.2	77	75.6	14.7	137	134.5	26.1	197	193.4	37.6	257	252.3	49.0
18	17.7	03.4	78	76.6	14.9	138	135.5	26.3	198	194.4	37.8	258	253.3	49.2
19	18.7	03.6	79	77.5	15.1	139	136.4	26.5	199	195.3	38.0	259	254.2	49.4
20	19.6	03.8	80	78.5	15.3	140	137.4	26.7	200	196.3	38.2	260	255.2	49.6
21	20.6	04.0	81	79.5	15.5	141	138.4	26.9	201	197.3	38.4	261	256.2	49.8
22	21.6	04.2	82	80.5	15.6	142	139.4	27.1	202	198.3	38.5	262	257.2	50.0
23	22.6	04.4	83	81.5	15.8	143	140.4	27.3	203	199.3	38.7	263	258.2	50.2
24	23.6	04.6	84	82.5	16.0	144	141.4	27.5	204	200.3	38.9	264	259.1	50.4
25	24.5	04.8	85	83.4	16.2	145	142.3	27.7	205	201.2	39.1	265	260.1	50.6
26	25.5	05.0	86	84.4	16.4	146	143.3	27.9	206	202.2	39.3	266	261.1	50.8
27	26.5	05.2	87	85.4	16.6	147	144.3	28.0	207	203.2	39.5	267	262.1	50.9
28	27.5	05.3	88	86.4	16.8	148	145.3	28.2	208	204.2	39.7	268	263.1	51.1
29	28.5	05.5	89	87.4	17.0	149	146.3	28.4	209	205.2	39.9	269	264.1	51.3
30	29.4	05.7	90	88.3	17.2	150	147.2	28.6	210	206.1	40.1	270	265.0	51.5
31	30.4	05.9	91	89.3	17.4	151	148.2	28.8	211	207.1	40.3	271	266.0	51.7
32	31.4	06.1	92	90.3	17.6	152	149.2	29.0	212	208.1	40.5	272	267.0	51.9
33	32.4	06.3	93	91.3	17.7	153	150.2	29.2	213	209.1	40.6	273	268.0	52.1
34	33.4	06.5	94	92.3	17.9	154	151.2	29.4	214	210.1	40.8	274	269.0	52.3
35	34.4	06.7	95	93.3	18.1	155	152.2	29.6	215	211.0	41.0	275	269.9	52.5
36	35.3	06.9	96	94.2	18.3	156	153.1	29.8	216	212.0	41.2	276	270.9	52.7
37	36.3	07.1	97	95.2	18.5	157	154.1	30.0	217	213.0	41.4	277	271.9	52.9
38	37.3	07.3	98	96.2	18.7	158	155.1	30.1	218	214.0	41.6	278	272.9	53.0
39	38.3	07.4	99	97.2	18.9	159	156.1	30.3	219	215.0	41.8	279	273.9	53.2
40	39.3	07.6	100	98.2	19.1	160	157.1	30.5	220	216.0	42.0	280	274.9	53.4
41	40.2	07.8	101	99.1	19.3	161	158.0	30.7	221	216.9	42.2	281	275.8	53.6
42	41.2	08.0	102	100.1	19.5	162	159.0	30.9	222	217.9	42.4	282	276.8	53.8
43	42.2	08.2	103	101.1	19.7	163	160.0	31.1	223	218.9	42.6	283	277.8	54.0
44	43.2	08.4	104	102.1	19.8	164	161.0	31.3	224	219.9	42.7	284	278.8	54.2
45	44.2	08.6	105	103.1	20.0	165	162.0	31.5	225	220.9	42.9	285	279.8	54.4
46	45.2	08.8	106	104.1	20.2	166	163.0	31.7	226	221.8	43.1	286	280.7	54.6
47	46.1	09.0	107	105.0	20.4	167	163.9	31.9	227	222.8	43.3	287	281.7	54.8
48	47.1	09.2	108	106.0	20.6	168	164.9	32.1	228	223.8	43.5	288	282.7	55.0
49	48.1	09.3	109	107.0	20.8	169	165.9	32.2	229	224.8	43.7	289	283.7	55.1
50	49.1	09.5	110	108.0	21.0	170	166.9	32.4	230	225.8	43.9	290	284.7	55.3
51	50.1	09.7	111	109.0	21.2	171	167.9	32.6	231	226.8	44.1	291	285.7	55.5
52	51.0	09.9	112	109.9	21.4	172	168.8	32.8	232	227.7	44.3	292	286.6	55.7
53	52.0	10.1	113	110.9	21.6	173	169.8	33.0	233	228.7	44.5	293	287.6	55.9
54	53.0	10.3	114	111.9	21.8	174	170.8	33.2	234	229.7	44.6	294	288.6	56.1
55	54.0	10.5	115	112.9	21.9	175	171.8	33.4	235	230.7	44.8	295	289.6	56.3
56	55.0	10.7	116	113.9	22.1	176	172.8	33.6	236	231.7	45.0	296	290.6	56.5
57	56.0	10.9	117	114.9	22.3	177	173.7	33.8	237	232.6	45.2	297	291.5	56.7
58	56.9	11.1	118	115.8	22.5	178	174.7	34.0	238	233.6	45.4	298	292.5	56.9
59	57.9	11.3	119	116.8	22.7	179	175.7	34.2	239	234.6	45.6	299	293.5	57.1
60	58.9	11.4	120	117.8	22.9	180	176.7	34.3	240	235.6	45.8	300	294.5	57.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 79 Degrees.

TABLE II.

Difference of Latitude and Departure for 12 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.7	12.7	121	118.4	25.2	181	177.0	37.6	241	235.7	50.1
2	02.0	00.4	62	60.6	12.9	122	119.3	25.4	182	178.0	37.8	242	236.7	50.3
3	02.9	00.6	63	61.6	13.1	123	120.3	25.6	183	179.0	38.0	243	237.7	50.5
4	03.9	00.8	64	62.6	13.3	124	121.3	25.8	184	180.0	38.3	244	238.7	50.7
5	04.9	01.0	65	63.6	13.5	125	122.3	26.0	185	181.0	38.5	245	239.6	50.9
6	05.9	01.2	66	64.6	13.7	126	123.2	26.2	186	181.9	38.7	246	240.6	51.1
7	06.8	01.5	67	65.5	13.9	127	124.2	26.4	187	182.9	38.9	247	241.6	51.4
8	07.8	01.7	68	66.5	14.1	128	125.2	26.6	188	183.9	39.1	248	242.6	51.6
9	08.8	01.9	69	67.5	14.3	129	126.2	26.8	189	184.9	39.3	249	243.6	51.8
10	09.8	02.1	70	68.5	14.6	130	127.2	27.0	190	185.8	39.5	250	244.5	52.0
11	10.8	02.3	71	69.4	14.8	131	128.1	27.2	191	186.8	39.7	251	245.5	52.2
12	11.7	02.5	72	70.4	15.0	132	129.1	27.4	192	187.8	39.9	252	246.5	52.4
13	12.7	02.7	73	71.4	15.2	133	130.1	27.7	193	188.8	40.1	253	247.5	52.6
14	13.7	02.9	74	72.4	15.4	134	131.1	27.9	194	189.8	40.3	254	248.4	52.8
15	14.7	03.1	75	73.4	15.6	135	132.0	28.1	195	190.7	40.5	255	249.4	53.0
16	15.7	03.3	76	74.3	15.8	136	133.0	28.3	196	191.7	40.8	256	250.4	53.2
17	16.6	03.5	77	75.3	16.0	137	134.0	28.5	197	192.7	41.0	257	251.4	53.4
18	17.6	03.7	78	76.3	16.2	138	135.0	28.7	198	193.7	41.2	258	252.4	53.6
19	18.6	04.0	79	77.3	16.4	139	136.0	28.9	199	194.7	41.4	259	253.3	53.8
20	19.6	04.2	80	78.3	16.6	140	136.9	29.1	200	195.6	41.6	260	254.3	54.1
21	20.5	04.4	81	79.2	16.8	141	137.9	29.3	201	196.6	41.8	261	255.3	54.3
22	21.5	04.6	82	80.2	17.0	142	138.9	29.5	202	197.6	42.0	262	256.3	54.5
23	22.5	04.8	83	81.2	17.3	143	139.9	29.7	203	198.6	42.2	263	257.3	54.7
24	23.5	05.0	84	82.2	17.5	144	140.9	29.9	204	199.5	42.4	264	258.2	54.9
25	24.5	05.2	85	83.1	17.7	145	141.8	30.1	205	200.5	42.6	265	259.2	55.1
26	25.4	05.4	86	84.1	17.9	146	142.8	30.4	206	201.5	42.8	266	260.2	55.3
27	26.4	05.6	87	85.1	18.1	147	143.8	30.6	207	202.5	43.0	267	261.2	55.5
28	27.4	05.8	88	86.1	18.3	148	144.8	30.8	208	203.5	43.2	268	262.1	55.7
29	28.4	06.0	89	87.1	18.5	149	145.7	31.0	209	204.4	43.5	269	263.1	55.9
30	29.3	06.2	90	88.0	18.7	150	146.7	31.2	210	205.4	43.7	270	264.1	56.1
31	30.3	06.4	91	89.0	18.9	151	147.7	31.4	211	206.4	43.9	271	265.1	56.3
32	31.3	06.7	92	90.0	19.1	152	148.7	31.6	212	207.4	44.1	272	266.1	56.6
33	32.3	06.9	93	91.0	19.3	153	149.7	31.8	213	208.3	44.3	273	267.0	56.8
34	33.3	07.1	94	91.9	19.5	154	150.6	32.0	214	209.3	44.5	274	268.0	57.0
35	34.2	07.3	95	92.9	19.8	155	151.6	32.2	215	210.3	44.7	275	269.0	57.2
36	35.2	07.5	96	93.9	20.0	156	152.6	32.4	216	211.3	44.9	276	270.0	57.4
37	36.2	07.7	97	94.9	20.2	157	153.6	32.6	217	212.3	45.1	277	270.9	57.6
38	37.2	07.9	98	95.9	20.4	158	154.5	32.9	218	213.2	45.3	278	271.9	57.8
39	38.1	08.1	99	96.8	20.6	159	155.5	33.1	219	214.2	45.5	279	272.9	58.0
40	39.1	08.3	100	97.8	20.8	160	156.5	33.3	220	215.2	45.7	280	273.9	58.2
41	40.1	08.5	101	98.8	21.0	161	157.5	33.5	221	216.2	45.9	281	274.9	58.4
42	41.1	08.7	102	99.8	21.2	162	158.5	33.7	222	217.1	46.2	282	275.8	58.6
43	42.1	08.9	103	100.7	21.4	163	159.4	33.9	223	218.1	46.4	283	276.8	58.8
44	43.0	09.1	104	101.7	21.6	164	160.4	34.1	224	219.1	46.6	284	277.8	59.0
45	44.0	09.4	105	102.7	21.8	165	161.4	34.3	225	220.1	46.8	285	278.8	59.3
46	45.0	09.6	106	103.7	22.0	166	162.4	34.5	226	221.1	47.0	286	279.8	59.5
47	46.0	09.8	107	104.7	22.2	167	163.4	34.7	227	222.0	47.2	287	280.7	59.7
48	47.0	10.0	108	105.6	22.5	168	164.3	34.9	228	223.0	47.4	288	281.7	59.9
49	47.9	10.2	109	106.6	22.7	169	165.3	35.1	229	224.0	47.6	289	282.7	60.1
50	48.9	10.4	110	107.6	22.9	170	166.3	35.3	230	225.0	47.8	290	283.7	60.3
51	49.9	10.6	111	108.6	23.1	171	167.3	35.6	231	226.0	48.0	291	284.6	60.5
52	50.9	10.8	112	109.6	23.3	172	168.2	35.8	232	226.9	48.2	292	285.6	60.7
53	51.8	11.0	113	110.5	23.5	173	169.2	36.0	233	227.9	48.4	293	286.6	60.9
54	52.8	11.2	114	111.5	23.7	174	170.2	36.2	234	228.9	48.7	294	287.6	61.1
55	53.8	11.4	115	112.5	23.9	175	171.2	36.4	235	229.9	48.9	295	288.6	61.3
56	54.8	11.6	116	113.5	24.1	176	172.2	36.6	236	230.8	49.1	296	289.5	61.5
57	55.8	11.9	117	114.4	24.3	177	173.1	36.8	237	231.8	49.3	297	290.5	61.7
58	56.7	12.1	118	115.4	24.5	178	174.1	37.0	238	232.8	49.5	298	291.5	62.0
59	57.7	12.3	119	116.4	24.7	179	175.1	37.2	239	233.8	49.7	299	292.5	62.2
60	58.7	12.5	120	117.4	24.9	180	176.1	37.4	240	234.8	49.9	300	293.4	62.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 78 Degrees.

TABLE II.

Difference of Latitude and Departure for 13 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.4	13.7	121	117.9	27.2	181	176.4	40.7	241	234.8	54.2
2	01.9	00.4	62	60.4	13.9	122	118.9	27.4	182	177.3	40.9	242	235.8	54.4
3	02.9	00.7	63	61.4	14.2	123	119.8	27.7	183	178.3	41.2	243	236.8	54.7
4	03.9	00.9	64	62.4	14.4	124	120.8	27.9	184	179.3	41.4	244	237.7	54.9
5	04.9	01.1	65	63.3	14.6	125	121.8	28.1	185	180.3	41.6	245	238.7	55.1
6	05.8	01.3	66	64.3	14.8	126	122.8	28.3	186	181.2	41.8	246	239.7	55.3
7	06.8	01.6	67	65.3	15.1	127	123.7	28.6	187	182.2	42.1	247	240.7	55.6
8	07.8	01.8	68	66.3	15.3	128	124.7	28.8	188	183.2	42.3	248	241.6	55.8
9	08.8	02.0	69	67.2	15.5	129	125.7	29.0	189	184.2	42.5	249	242.6	56.0
10	09.7	02.2	70	68.2	15.7	130	126.7	29.2	190	185.1	42.7	250	243.6	56.2
11	10.7	02.5	71	69.2	16.0	131	127.6	29.5	191	186.1	43.0	251	244.6	56.5
12	11.7	02.7	72	70.2	16.2	132	128.6	29.7	192	187.1	43.2	252	245.5	56.7
13	12.7	02.9	73	71.1	16.4	133	129.6	29.9	193	188.1	43.4	253	246.5	56.9
14	13.6	03.1	74	72.1	16.6	134	130.6	30.1	194	189.0	43.6	254	247.5	57.1
15	14.6	03.4	75	73.1	16.9	135	131.5	30.4	195	190.0	43.9	255	248.5	57.4
16	15.6	03.6	76	74.1	17.1	136	132.5	30.6	196	191.0	44.1	256	249.4	57.6
17	16.6	03.8	77	75.0	17.3	137	133.5	30.8	197	192.0	44.3	257	250.4	57.8
18	17.5	04.0	78	76.0	17.5	138	134.5	31.0	198	192.9	44.5	258	251.4	58.0
19	18.5	04.3	79	77.0	17.8	139	135.4	31.3	199	193.9	44.8	259	252.4	58.3
20	19.5	04.5	80	77.9	18.0	140	136.4	31.5	200	194.9	45.0	260	253.3	58.5
21	20.5	04.7	81	78.9	18.2	141	137.4	31.7	201	195.8	45.2	261	254.3	58.7
22	21.4	04.9	82	79.9	18.4	142	138.4	31.9	202	196.8	45.4	262	255.3	58.9
23	22.4	05.2	83	80.9	18.7	143	139.3	32.2	203	197.8	45.7	263	256.3	59.2
24	23.4	05.4	84	81.8	18.9	144	140.3	32.4	204	198.8	45.9	264	257.2	59.4
25	24.4	05.6	85	82.8	19.1	145	141.3	32.6	205	199.7	46.1	265	258.2	59.6
26	25.3	05.8	86	83.8	19.3	146	142.3	32.8	206	200.7	46.3	266	259.2	59.8
27	26.3	06.1	87	84.8	19.6	147	143.2	33.1	207	201.7	46.6	267	260.2	60.1
28	27.3	06.3	88	85.7	19.8	148	144.2	33.3	208	202.7	46.8	268	261.1	60.3
29	28.3	06.5	89	86.7	20.0	149	145.2	33.5	209	203.6	47.0	269	262.1	60.5
30	29.2	06.7	90	87.7	20.2	150	146.2	33.7	210	204.6	47.2	270	263.1	60.7
31	30.2	07.0	91	88.7	20.5	151	147.1	34.0	211	205.6	47.5	271	264.1	61.0
32	31.2	07.2	92	89.6	20.7	152	148.1	34.2	212	206.6	47.7	272	265.0	61.2
33	32.2	07.4	93	90.6	20.9	153	149.1	34.4	213	207.5	47.9	273	266.0	61.4
34	33.1	07.6	94	91.6	21.1	154	150.1	34.6	214	208.5	48.1	274	267.0	61.6
35	34.1	07.9	95	92.6	21.4	155	151.0	34.9	215	209.5	48.4	275	268.0	61.9
36	35.1	08.1	96	93.5	21.6	156	152.0	35.1	216	210.5	48.6	276	268.9	62.1
37	36.1	08.3	97	94.5	21.8	157	153.0	35.3	217	211.4	48.8	277	269.9	62.3
38	37.0	08.5	98	95.5	22.0	158	154.0	35.5	218	212.4	49.0	278	270.9	62.5
39	38.0	08.8	99	96.5	22.3	159	154.9	35.8	219	213.4	49.3	279	271.8	62.8
40	39.0	09.0	100	97.4	22.5	160	155.9	36.0	220	214.4	49.5	280	272.8	63.0
41	39.9	09.2	101	98.4	22.7	161	156.9	36.2	221	215.3	49.7	281	273.8	63.2
42	40.9	09.4	102	99.4	22.9	162	157.8	36.4	222	216.3	49.9	282	274.8	63.4
43	41.9	09.7	103	100.4	23.2	163	158.8	36.7	223	217.3	50.2	283	275.7	63.7
44	42.9	09.9	104	101.3	23.4	164	159.8	36.9	224	218.3	50.4	284	276.7	63.9
45	43.8	10.1	105	102.3	23.6	165	160.8	37.1	225	219.2	50.6	285	277.7	64.1
46	44.8	10.3	106	103.3	23.8	166	161.7	37.3	226	220.2	50.8	286	278.7	64.3
47	45.8	10.6	107	104.3	24.1	167	162.7	37.6	227	221.2	51.1	287	279.6	64.6
48	46.8	10.8	108	105.2	24.3	168	163.7	37.8	228	222.2	51.3	288	280.6	64.8
49	47.7	11.0	109	106.2	24.5	169	164.7	38.0	229	223.1	51.5	289	281.6	65.0
50	48.7	11.2	110	107.2	24.7	170	165.6	38.2	230	224.1	51.7	290	282.6	65.2
51	49.7	11.5	111	108.2	25.0	171	166.6	38.5	231	225.1	52.0	291	283.5	65.5
52	50.7	11.7	112	109.1	25.2	172	167.6	38.7	232	226.1	52.2	292	284.5	65.7
53	51.6	11.9	113	110.1	25.4	173	168.6	38.9	233	227.0	52.4	293	285.5	65.9
54	52.6	12.1	114	111.1	25.6	174	169.5	39.1	234	228.0	52.6	294	286.5	66.1
55	53.6	12.4	115	112.1	25.9	175	170.5	39.4	235	229.0	52.9	295	287.4	66.4
56	54.6	12.6	116	113.0	26.1	176	171.5	39.6	236	230.0	53.1	296	288.4	66.6
57	55.5	12.8	117	114.0	26.3	177	172.5	39.8	237	230.9	53.3	297	289.4	66.8
58	56.5	13.0	118	115.0	26.5	178	173.4	40.0	238	231.9	53.5	298	290.4	67.0
59	57.5	13.3	119	116.0	26.8	179	174.4	40.3	239	232.9	53.8	299	291.3	67.3
60	58.5	13.5	120	116.9	27.0	180	175.4	40.5	240	233.8	54.0	300	292.3	67.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 77 Degrees.

TABLE II.

Difference of Latitude and Departure for 14 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.2	14.8	121	117.4	29.3	181	175.6	43.8	241	233.8	58.3
2	01.9	00.5	62	60.2	15.0	122	118.4	29.5	182	176.6	44.0	242	234.8	58.5
3	02.9	00.7	63	61.1	15.2	123	119.3	29.8	183	177.6	44.3	243	235.8	58.8
4	03.9	01.0	64	62.1	15.5	124	120.3	30.0	184	178.5	44.5	244	236.8	59.0
5	04.9	01.2	65	63.1	15.7	125	121.3	30.2	185	179.5	44.8	245	237.7	59.3
6	05.8	01.5	66	64.0	16.0	126	122.3	30.5	186	180.5	45.0	246	238.7	59.5
7	06.8	01.7	67	65.0	16.2	127	123.2	30.7	187	181.4	45.2	247	239.7	59.8
8	07.8	01.9	68	66.0	16.5	128	124.2	31.0	188	182.4	45.5	248	240.6	60.0
9	08.7	02.2	69	67.0	16.7	129	125.2	31.2	189	183.4	45.7	249	241.6	60.2
10	09.7	02.4	70	67.9	16.9	130	126.1	31.4	190	184.4	46.0	250	242.6	60.5
11	10.7	02.7	71	68.9	17.2	131	127.1	31.7	191	185.3	46.2	251	243.5	60.7
12	11.6	02.9	72	69.9	17.4	132	128.1	31.9	192	186.3	46.4	252	244.5	61.0
13	12.6	03.1	73	70.8	17.7	133	129.0	32.2	193	187.3	46.7	253	245.5	61.2
14	13.6	03.4	74	71.8	17.9	134	130.0	32.4	194	188.2	46.9	254	246.5	61.4
15	14.6	03.6	75	72.8	18.1	135	131.0	32.7	195	189.2	47.2	255	247.4	61.7
16	15.5	03.9	76	73.7	18.4	136	132.0	32.9	196	190.2	47.4	256	248.4	61.9
17	16.5	04.1	77	74.7	18.6	137	132.9	33.1	197	191.1	47.7	257	249.4	62.2
18	17.5	04.4	78	75.7	18.9	138	133.9	33.4	198	192.1	47.9	258	250.3	62.4
19	18.4	04.6	79	76.7	19.1	139	134.9	33.6	199	193.1	48.1	259	251.3	62.7
20	19.4	04.8	80	77.6	19.4	140	135.8	33.9	200	194.1	48.4	260	252.3	62.9
21	20.4	05.1	81	78.6	19.6	141	136.8	34.1	201	195.0	48.6	261	253.2	63.1
22	21.3	05.3	82	79.6	19.8	142	137.8	34.4	202	196.0	48.9	262	254.2	63.4
23	22.3	05.6	83	80.5	20.1	143	138.8	34.6	203	197.0	49.1	263	255.2	63.6
24	23.3	05.8	84	81.5	20.3	144	139.7	34.8	204	197.9	49.4	264	256.2	63.9
25	24.3	06.0	85	82.5	20.6	145	140.7	35.1	205	198.9	49.6	265	257.1	64.1
26	25.2	06.3	86	83.4	20.8	146	141.7	35.3	206	199.9	49.8	266	258.1	64.4
27	26.2	06.5	87	84.4	21.0	147	142.6	35.6	207	200.9	50.1	267	259.1	64.6
28	27.2	06.8	88	85.4	21.3	148	143.6	35.8	208	201.8	50.3	268	260.0	64.8
29	28.1	07.0	89	86.4	21.5	149	144.6	36.0	209	202.8	50.6	269	261.0	65.1
30	29.1	07.3	90	87.3	21.8	150	145.5	36.3	210	203.8	50.8	270	262.0	65.3
31	30.1	07.5	91	88.3	22.0	151	146.5	36.5	211	204.7	51.0	271	263.0	65.6
32	31.0	07.7	92	89.3	22.3	152	147.5	36.8	212	205.7	51.3	272	263.9	65.8
33	32.0	08.0	93	90.2	22.5	153	148.5	37.0	213	206.7	51.5	273	264.9	66.0
34	33.0	08.2	94	91.2	22.7	154	149.4	37.3	214	207.6	51.8	274	265.9	66.3
35	34.0	08.5	95	92.2	23.0	155	150.4	37.5	215	208.6	52.0	275	266.8	66.5
36	34.9	08.7	96	93.1	23.2	156	151.4	37.7	216	209.6	52.3	276	267.8	66.8
37	35.9	09.0	97	94.1	23.5	157	152.3	38.0	217	210.6	52.5	277	268.8	67.0
38	36.9	09.2	98	95.1	23.7	158	153.3	38.2	218	211.5	52.7	278	269.7	67.3
39	37.8	09.4	99	96.1	24.0	159	154.3	38.5	219	212.5	53.0	279	270.7	67.5
40	38.8	09.7	100	97.0	24.2	160	155.2	38.7	220	213.5	53.2	280	271.7	67.7
41	39.8	09.9	101	98.0	24.4	161	156.2	38.9	221	214.4	53.5	281	272.7	68.0
42	40.8	10.2	102	99.0	24.7	162	157.2	39.2	222	215.4	53.7	282	273.6	68.2
43	41.7	10.4	103	99.9	24.9	163	158.2	39.4	223	216.4	53.9	283	274.6	68.5
44	42.7	10.6	104	100.9	25.2	164	159.1	39.7	224	217.3	54.2	284	275.6	68.7
45	43.7	10.9	105	101.9	25.4	165	160.1	39.9	225	218.3	54.4	285	276.5	68.9
46	44.6	11.1	106	102.9	25.6	166	161.1	40.2	226	219.3	54.7	286	277.5	69.2
47	45.6	11.4	107	103.8	25.9	167	162.0	40.4	227	220.3	54.9	287	278.5	69.4
48	46.6	11.6	108	104.8	26.1	168	163.0	40.6	228	221.2	55.2	288	279.4	69.7
49	47.5	11.9	109	105.8	26.4	169	164.0	40.9	229	222.2	55.4	289	280.4	69.9
50	48.5	12.1	110	106.7	26.6	170	165.0	41.1	230	223.2	55.6	290	281.4	70.2
51	49.5	12.3	111	107.7	26.9	171	165.9	41.4	231	224.1	55.9	291	282.4	70.4
52	50.5	12.6	112	108.7	27.1	172	166.9	41.6	232	225.1	56.1	292	283.3	70.6
53	51.4	12.8	113	109.6	27.3	173	167.9	41.9	233	226.1	56.4	293	284.3	70.9
54	52.4	13.1	114	110.6	27.6	174	168.8	42.1	234	227.0	56.6	294	285.3	71.1
55	53.4	13.3	115	111.6	27.8	175	169.8	42.3	235	228.0	56.9	295	286.2	71.4
56	54.3	13.5	116	112.6	28.1	176	170.8	42.6	236	229.0	57.1	296	287.2	71.6
57	55.3	13.8	117	113.5	28.3	177	171.7	42.8	237	230.0	57.3	297	288.2	71.9
58	56.3	14.0	118	114.5	28.6	178	172.7	43.1	238	230.9	57.6	298	289.1	72.1
59	57.2	14.3	119	115.5	28.8	179	173.7	43.3	239	231.9	57.8	299	290.1	72.3
60	58.2	14.5	120	116.4	29.0	180	174.7	43.5	240	232.9	58.1	300	291.1	72.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 76 Degrees.

TABLE II.

Difference of Latitude and Departure for 15 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.9	15.8	121	116.9	31.3	181	174.8	46.8	241	232.8	62.4
2	01.9	00.5	62	59.9	16.0	122	117.8	31.6	182	175.8	47.1	242	233.8	62.6
3	02.9	00.8	63	60.9	16.3	123	118.8	31.8	183	176.8	47.4	243	234.7	62.9
4	03.9	01.0	64	61.8	16.6	124	119.8	32.1	184	177.7	47.6	244	235.7	63.2
5	04.8	01.3	65	62.8	16.8	125	120.7	32.4	185	178.7	47.9	245	236.7	63.4
6	05.8	01.6	66	63.8	17.1	126	121.7	32.6	186	179.7	48.1	246	237.6	63.7
7	06.8	01.8	67	64.7	17.3	127	122.7	32.9	187	180.6	48.4	247	238.6	63.9
8	07.7	02.1	68	65.7	17.6	128	123.6	33.1	188	181.6	48.7	248	239.5	64.2
9	08.7	02.3	69	66.6	17.9	129	124.6	33.4	189	182.6	48.9	249	240.5	64.4
10	09.7	02.6	70	67.6	18.1	130	125.6	33.6	190	183.5	49.2	250	241.5	64.7
11	10.6	02.8	71	68.6	18.4	131	126.5	33.9	191	184.5	49.4	251	242.4	65.0
12	11.6	03.1	72	69.5	18.6	132	127.5	34.2	192	185.5	49.7	252	243.4	65.2
13	12.6	03.4	73	70.5	18.9	133	128.5	34.4	193	186.4	50.0	253	244.4	65.5
14	13.5	03.6	74	71.5	19.2	134	129.4	34.7	194	187.4	50.2	254	245.3	65.7
15	14.5	03.9	75	72.4	19.4	135	130.4	34.9	195	188.4	50.5	255	246.3	66.0
16	15.5	04.1	76	73.4	19.7	136	131.4	35.2	196	189.3	50.7	256	247.3	66.3
17	16.4	04.4	77	74.4	19.9	137	132.3	35.5	197	190.3	51.0	257	248.2	66.5
18	17.4	04.7	78	75.3	20.2	138	133.3	35.7	198	191.3	51.2	258	249.2	66.8
19	18.4	04.9	79	76.3	20.4	139	134.3	36.0	199	192.2	51.5	259	250.2	67.0
20	19.3	05.2	80	77.3	20.7	140	135.2	36.2	200	193.2	51.8	260	251.1	67.3
21	20.3	05.4	81	78.2	21.0	141	136.2	36.5	201	194.2	52.0	261	252.1	67.6
22	21.3	05.7	82	79.2	21.2	142	137.2	36.8	202	195.1	52.3	262	253.1	67.8
23	22.2	06.0	83	80.2	21.5	143	138.1	37.0	203	196.1	52.5	263	254.0	68.1
24	23.2	06.2	84	81.1	21.7	144	139.1	37.3	204	197.0	52.8	264	255.0	68.3
25	24.1	06.5	85	82.1	22.0	145	140.1	37.5	205	198.0	53.1	265	256.0	68.6
26	25.1	06.7	86	83.1	22.3	146	141.0	37.8	206	199.0	53.3	266	256.9	68.8
27	26.1	07.0	87	84.0	22.5	147	142.0	38.0	207	199.9	53.6	267	257.9	69.1
28	27.0	07.2	88	85.0	22.8	148	143.0	38.3	208	200.9	53.8	268	258.9	69.4
29	28.0	07.5	89	86.0	23.0	149	143.9	38.6	209	201.9	54.1	269	259.8	69.6
30	29.0	07.8	90	86.9	23.3	150	144.9	38.8	210	202.8	54.4	270	260.8	69.9
31	29.9	08.0	91	87.9	23.6	151	145.9	39.1	211	203.8	54.6	271	261.8	70.1
32	30.9	08.3	92	88.9	23.8	152	146.8	39.3	212	204.8	54.9	272	262.7	70.4
33	31.9	08.5	93	89.8	24.1	153	147.8	39.6	213	205.7	55.1	273	263.7	70.7
34	32.8	08.8	94	90.8	24.3	154	148.8	39.9	214	206.7	55.4	274	264.7	70.9
35	33.8	09.1	95	91.8	24.6	155	149.7	40.1	215	207.7	55.6	275	265.6	71.2
36	34.8	09.3	96	92.7	24.8	156	150.7	40.4	216	208.6	55.9	276	266.6	71.4
37	35.7	09.6	97	93.7	25.1	157	151.7	40.6	217	209.6	56.2	277	267.6	71.7
38	36.7	09.8	98	94.7	25.4	158	152.6	40.9	218	210.6	56.4	278	268.5	72.0
39	37.7	10.1	99	95.6	25.6	159	153.6	41.2	219	211.5	56.7	279	269.5	72.2
40	38.6	10.4	100	96.6	25.9	160	154.5	41.4	220	212.5	56.9	280	270.5	72.5
41	39.6	10.6	101	97.6	26.1	161	155.5	41.7	221	213.5	57.2	281	271.4	72.7
42	40.6	10.9	102	98.5	26.4	162	156.5	41.9	222	214.4	57.5	282	272.4	73.0
43	41.5	11.1	103	99.5	26.7	163	157.4	42.2	223	215.4	57.7	283	273.4	73.2
44	42.5	11.4	104	100.5	26.9	164	158.4	42.4	224	216.4	58.0	284	274.3	73.5
45	43.5	11.6	105	101.4	27.2	165	159.4	42.7	225	217.3	58.2	285	275.3	73.8
46	44.4	11.9	106	102.4	27.4	166	160.3	43.0	226	218.3	58.5	286	276.3	74.0
47	45.4	12.2	107	103.4	27.7	167	161.3	43.2	227	219.3	58.8	287	277.2	74.3
48	46.4	12.4	108	104.3	28.0	168	162.3	43.5	228	220.2	59.0	288	278.2	74.5
49	47.3	12.7	109	105.3	28.2	169	163.2	43.7	229	221.2	59.3	289	279.2	74.8
50	48.3	12.9	110	106.3	28.5	170	164.2	44.0	230	222.2	59.5	290	280.1	75.1
51	49.3	13.2	111	107.2	28.7	171	165.2	44.3	231	223.1	59.8	291	281.1	75.3
52	50.2	13.5	112	108.2	29.0	172	166.1	44.5	232	224.1	60.0	292	282.1	75.6
53	51.2	13.7	113	109.1	29.2	173	167.1	44.8	233	225.1	60.3	293	283.0	75.8
54	52.2	14.0	114	110.1	29.5	174	168.1	45.0	234	226.0	60.6	294	284.0	76.1
55	53.1	14.2	115	111.1	29.8	175	169.0	45.3	235	227.0	60.8	295	284.9	76.4
56	54.1	14.5	116	112.0	30.0	176	170.0	45.6	236	228.0	61.1	296	285.9	76.6
57	55.1	14.8	117	113.0	30.3	177	171.0	45.8	237	228.9	61.3	297	286.9	76.9
58	56.0	15.0	118	114.0	30.5	178	171.9	46.1	238	229.9	61.6	298	287.8	77.1
59	57.0	15.3	119	114.9	30.8	179	172.9	46.3	239	230.9	61.9	299	288.8	77.4
60	58.0	15.5	120	115.9	31.1	180	173.9	46.6	240	231.8	62.1	300	289.8	77.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 75 Degrees.

TABLE II.

Difference of Latitude and Departure for 16 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.6	16.8	121	116.3	33.4	181	174.0	49.9	241	231.7	66.4
2	01.9	00.6	62	59.6	17.1	122	117.3	33.6	182	174.9	50.2	242	232.6	66.7
3	02.9	00.8	63	60.6	17.4	123	118.2	33.9	183	175.9	50.4	243	233.6	67.0
4	03.8	01.1	64	61.5	17.6	124	119.2	34.2	184	176.9	50.7	244	234.5	67.3
5	04.8	01.4	65	62.5	17.9	125	120.2	34.5	185	177.8	51.0	245	235.5	67.5
6	05.8	01.7	66	63.4	18.2	126	121.1	34.7	186	178.8	51.3	246	236.5	67.8
7	06.7	01.9	67	64.4	18.5	127	122.1	35.0	187	179.8	51.5	247	237.4	68.1
8	07.7	02.2	68	65.4	18.7	128	123.0	35.3	188	180.7	51.8	248	238.4	68.4
9	08.7	02.5	69	66.3	19.0	129	124.0	35.6	189	181.7	52.1	249	239.4	68.6
10	09.6	02.8	70	67.3	19.3	130	125.0	35.8	190	182.6	52.4	250	240.3	68.9
11	10.6	03.0	71	68.2	19.6	131	125.9	36.1	191	183.6	52.6	251	241.3	69.2
12	11.5	03.3	72	69.2	19.8	132	126.9	36.4	192	184.6	52.9	252	242.2	69.5
13	12.5	03.6	73	70.2	20.1	133	127.8	36.7	193	185.5	53.2	253	243.2	69.7
14	13.5	03.9	74	71.1	20.4	134	128.8	36.9	194	186.5	53.5	254	244.2	70.0
15	14.4	04.1	75	72.1	20.7	135	129.8	37.2	195	187.4	53.7	255	245.1	70.3
16	15.4	04.4	76	73.1	20.9	136	130.7	37.5	196	188.4	54.0	256	246.1	70.6
17	16.3	04.7	77	74.0	21.2	137	131.7	37.8	197	189.4	54.3	257	247.0	70.8
18	17.3	05.0	78	75.0	21.5	138	132.7	38.0	198	190.3	54.6	258	248.0	71.1
19	18.3	05.2	79	75.9	21.8	139	133.6	38.3	199	191.3	54.9	259	249.0	71.4
20	19.2	05.5	80	76.9	22.1	140	134.6	38.6	200	192.3	55.1	260	249.9	71.7
21	20.2	05.8	81	77.9	22.3	141	135.5	38.9	201	193.2	55.4	261	250.9	71.9
22	21.1	06.1	82	78.8	22.6	142	136.5	39.1	202	194.2	55.7	262	251.9	72.2
23	22.1	06.3	83	79.8	22.9	143	137.5	39.4	203	195.1	56.0	263	252.8	72.5
24	23.1	06.6	84	80.7	23.2	144	138.4	39.7	204	196.1	56.2	264	253.8	72.8
25	24.0	06.9	85	81.7	23.4	145	139.4	40.0	205	197.1	56.5	265	254.7	73.0
26	25.0	07.2	86	82.7	23.7	146	140.3	40.2	206	198.0	56.8	266	255.7	73.3
27	26.0	07.4	87	83.6	24.0	147	141.3	40.5	207	199.0	57.1	267	256.7	73.6
28	26.9	07.7	88	84.6	24.3	148	142.3	40.8	208	199.9	57.3	268	257.6	73.9
29	27.9	08.0	89	85.6	24.5	149	143.2	41.1	209	200.9	57.6	269	258.6	74.1
30	28.8	08.3	90	86.5	24.8	150	144.2	41.3	210	201.9	57.9	270	259.5	74.4
31	29.8	08.5	91	87.5	25.1	151	145.2	41.6	211	202.8	58.2	271	260.5	74.7
32	30.8	08.8	92	88.4	25.4	152	146.1	41.9	212	203.8	58.4	272	261.5	75.0
33	31.7	09.1	93	89.4	25.6	153	147.1	42.2	213	204.7	58.7	273	262.4	75.2
34	32.7	09.4	94	90.4	25.9	154	148.0	42.4	214	205.7	59.0	274	263.4	75.5
35	33.6	09.6	95	91.3	26.2	155	149.0	42.7	215	206.7	59.3	275	264.3	75.8
36	34.6	09.9	96	92.3	26.5	156	150.0	43.0	216	207.6	59.5	276	265.3	76.1
37	35.6	10.2	97	93.2	26.7	157	150.9	43.3	217	208.6	59.8	277	266.3	76.4
38	36.5	10.5	98	94.2	27.0	158	151.9	43.6	218	209.6	60.1	278	267.2	76.6
39	37.5	10.7	99	95.2	27.3	159	152.8	43.8	219	210.5	60.4	279	268.2	76.9
40	38.5	11.0	100	96.1	27.6	160	153.8	44.1	220	211.5	60.6	280	269.2	77.2
41	39.4	11.3	101	97.1	27.8	161	154.8	44.4	221	212.4	60.9	281	270.1	77.5
42	40.4	11.6	102	98.0	28.1	162	155.7	44.7	222	213.4	61.2	282	271.1	77.7
43	41.3	11.9	103	99.0	28.4	163	156.7	44.9	223	214.4	61.5	283	272.0	78.0
44	42.3	12.1	104	100.0	28.7	164	157.6	45.2	224	215.3	61.7	284	273.0	78.3
45	43.3	12.4	105	100.9	28.9	165	158.6	45.5	225	216.3	62.0	285	274.0	78.6
46	44.2	12.7	106	101.9	29.2	166	159.6	45.8	226	217.2	62.3	286	274.9	78.8
47	45.2	13.0	107	102.9	29.5	167	160.5	46.0	227	218.2	62.6	287	275.9	79.1
48	46.1	13.2	108	103.8	29.8	168	161.5	46.3	228	219.2	62.8	288	276.8	79.4
49	47.1	13.5	109	104.8	30.0	169	162.5	46.6	229	220.1	63.1	289	277.8	79.7
50	48.1	13.8	110	105.7	30.3	170	163.4	46.9	230	221.1	63.4	290	278.8	79.9
51	49.0	14.1	111	106.7	30.6	171	164.4	47.1	231	222.1	63.7	291	279.7	80.2
52	50.0	14.3	112	107.7	30.9	172	165.3	47.4	232	223.0	63.9	292	280.7	80.5
53	50.9	14.6	113	108.6	31.1	173	166.3	47.7	233	224.0	64.2	293	281.6	80.8
54	51.9	14.9	114	109.6	31.4	174	167.3	48.0	234	224.9	64.5	294	282.6	81.0
55	52.9	15.2	115	110.5	31.7	175	168.2	48.2	235	225.9	64.8	295	283.6	81.3
56	53.8	15.4	116	111.5	32.0	176	169.2	48.5	236	226.9	65.1	296	284.5	81.6
57	54.8	15.7	117	112.5	32.2	177	170.1	48.8	237	227.8	65.3	297	285.5	81.9
58	55.8	16.0	118	113.4	32.5	178	171.1	49.1	238	228.8	65.6	298	286.5	82.1
59	56.7	16.3	119	114.4	32.8	179	172.1	49.3	239	229.7	65.9	299	287.4	82.4
60	57.7	16.5	120	115.4	33.1	180	173.0	49.6	240	230.7	66.2	300	288.4	82.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat

for 74 Degrees.

TABLE II.

Difference of Latitude and Departure for 17 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.3	17.8	121	115.7	35.4	181	173.1	52.9	241	230.5	70.5
2	01.9	00.6	62	59.3	18.1	122	116.7	35.7	182	174.0	53.2	242	231.4	70.8
3	02.9	00.9	63	60.2	18.4	123	117.6	36.0	183	175.0	53.5	243	232.4	71.0
4	03.8	01.2	64	61.2	18.7	124	118.6	36.3	184	176.0	53.8	244	233.3	71.3
5	04.8	01.5	65	62.2	19.0	125	119.5	36.5	185	176.9	54.1	245	234.3	71.6
6	05.7	01.8	66	63.1	19.3	126	120.5	36.8	186	177.9	54.4	246	235.3	71.9
7	06.7	02.0	67	64.1	19.6	127	121.5	37.1	187	178.8	54.7	247	236.2	72.2
8	07.7	02.3	68	65.0	19.9	128	122.4	37.4	188	179.8	55.0	248	237.2	72.5
9	08.6	02.6	69	66.0	20.2	129	123.4	37.7	189	180.7	55.3	249	238.1	72.8
10	09.6	02.9	70	66.9	20.5	130	124.3	38.0	190	181.7	55.6	250	239.1	73.1
11	10.5	03.2	71	67.9	20.8	131	125.3	38.3	191	182.7	55.8	251	240.0	73.4
12	11.5	03.5	72	68.9	21.1	132	126.2	38.6	192	183.6	56.1	252	241.0	73.7
13	12.4	03.8	73	69.8	21.3	133	127.2	38.9	193	184.6	56.4	253	241.9	74.0
14	13.4	04.1	74	70.8	21.6	134	128.1	39.2	194	185.5	56.7	254	242.9	74.3
15	14.3	04.4	75	71.7	21.9	135	129.1	39.5	195	186.5	57.0	255	243.9	74.6
16	15.3	04.7	76	72.7	22.2	136	130.1	39.8	196	187.4	57.3	256	244.8	74.8
17	16.3	05.0	77	73.6	22.5	137	131.0	40.1	197	188.4	57.6	257	245.8	75.1
18	17.2	05.3	78	74.6	22.8	138	132.0	40.3	198	189.3	57.9	258	246.7	75.4
19	18.2	05.6	79	75.5	23.1	139	132.9	40.6	199	190.3	58.2	259	247.7	75.7
20	19.1	05.8	80	76.5	23.4	140	133.9	40.9	200	191.3	58.5	260	248.6	76.0
21	20.1	06.1	81	77.5	23.7	141	134.8	41.2	201	192.2	58.8	261	249.6	76.3
22	21.0	06.4	82	78.4	24.0	142	135.8	41.5	202	193.2	59.1	262	250.6	76.6
23	22.0	06.7	83	79.4	24.3	143	136.8	41.8	203	194.1	59.4	263	251.5	76.9
24	23.0	07.0	84	80.3	24.6	144	137.7	42.1	204	195.1	59.6	264	252.5	77.2
25	23.9	07.3	85	81.3	24.9	145	138.7	42.4	205	196.0	59.9	265	253.4	77.5
26	24.9	07.6	86	82.2	25.1	146	139.6	42.7	206	197.0	60.2	266	254.4	77.8
27	25.8	07.9	87	83.2	25.4	147	140.6	43.0	207	198.0	60.5	267	255.3	78.1
28	26.8	08.2	88	84.2	25.7	148	141.5	43.3	208	198.9	60.8	268	256.3	78.4
29	27.7	08.5	89	85.1	26.0	149	142.5	43.6	209	199.9	61.1	269	257.2	78.6
30	28.7	08.8	90	86.1	26.3	150	143.4	43.9	210	200.8	61.4	270	258.2	78.9
31	29.6	09.1	91	87.0	26.6	151	144.4	44.1	211	201.8	61.7	271	259.2	79.2
32	30.6	09.4	92	88.0	26.9	152	145.4	44.4	212	202.7	62.0	272	260.1	79.5
33	31.6	09.6	93	88.9	27.2	153	146.3	44.7	213	203.7	62.3	273	261.1	79.8
34	32.5	09.9	94	89.9	27.5	154	147.3	45.0	214	204.6	62.6	274	262.0	80.1
35	33.5	10.2	95	90.8	27.8	155	148.2	45.3	215	205.6	62.9	275	263.0	80.4
36	34.4	10.5	96	91.8	28.1	156	149.2	45.6	216	206.6	63.2	276	263.9	80.7
37	35.4	10.8	97	92.8	28.4	157	150.1	45.9	217	207.5	63.4	277	264.9	81.0
38	36.3	11.1	98	93.7	28.7	158	151.1	46.2	218	208.5	63.7	278	265.9	81.3
39	37.3	11.4	99	94.7	28.9	159	152.1	46.5	219	209.4	64.0	279	266.8	81.6
40	38.3	11.7	100	95.6	29.2	160	153.0	46.8	220	210.4	64.3	280	267.8	81.9
41	39.2	12.0	101	96.6	29.5	161	154.0	47.1	221	211.3	64.6	281	268.7	82.2
42	40.2	12.3	102	97.5	29.8	162	154.9	47.4	222	212.3	64.9	282	269.7	82.4
43	41.1	12.6	103	98.5	30.1	163	155.9	47.7	223	213.3	65.2	283	270.6	82.7
44	42.1	12.9	104	99.5	30.4	164	156.8	47.9	224	214.2	65.5	284	271.6	83.0
45	43.0	13.2	105	100.4	30.7	165	157.8	48.2	225	215.2	65.8	285	272.5	83.3
46	44.0	13.4	106	101.4	31.0	166	158.7	48.5	226	216.1	66.1	286	273.5	83.6
47	44.9	13.7	107	102.3	31.3	167	159.7	48.8	227	217.1	66.4	287	274.5	83.9
48	45.9	14.0	108	103.3	31.6	168	160.7	49.1	228	218.0	66.7	288	275.4	84.2
49	46.9	14.3	109	104.2	31.9	169	161.6	49.4	229	219.0	67.0	289	276.4	84.5
50	47.8	14.6	110	105.2	32.2	170	162.6	49.7	230	220.0	67.2	290	277.3	84.8
51	48.8	14.9	111	106.1	32.5	171	163.5	50.0	231	220.9	67.5	291	278.3	85.1
52	49.7	15.2	112	107.1	32.7	172	164.5	50.3	232	221.9	67.8	292	279.2	85.4
53	50.7	15.5	113	108.1	33.0	173	165.4	50.6	233	222.8	68.1	293	280.2	85.7
54	51.6	15.8	114	109.0	33.3	174	166.4	50.9	234	223.8	68.4	294	281.2	86.0
55	52.6	16.1	115	110.0	33.6	175	167.4	51.2	235	224.7	68.7	295	282.1	86.2
56	53.6	16.4	116	110.9	33.9	176	168.3	51.5	236	225.7	69.0	296	283.1	86.5
57	54.5	16.7	117	111.9	34.2	177	169.3	51.7	237	226.6	69.3	297	284.0	86.8
58	55.5	17.0	118	112.8	34.5	178	170.2	52.0	238	227.6	69.6	298	285.0	87.1
59	56.4	17.2	119	113.8	34.8	179	171.2	52.3	239	228.6	69.9	299	285.9	87.4
60	57.4	17.5	120	114.8	35.1	180	172.1	52.6	240	229.5	70.2	300	286.9	87.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 73 Degrees.

TABLE II.

Difference of Latitude and Departure for 18 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.0	18.9	121	115.1	37.4	181	172.1	55.9	241	229.2	74.5
2	01.9	00.6	62	59.0	19.2	122	116.0	37.7	182	173.1	56.2	242	230.2	74.8
3	02.9	00.9	63	59.9	19.5	123	117.0	38.0	183	174.0	56.6	243	231.1	75.1
4	03.8	01.2	64	60.9	19.8	124	117.9	38.3	184	175.0	56.9	244	232.1	75.4
5	04.8	01.5	65	61.8	20.1	125	118.9	38.6	185	175.9	57.2	245	233.0	75.7
6	05.7	01.9	66	62.8	20.4	126	119.8	38.9	186	176.9	57.5	246	234.0	76.0
7	06.7	02.2	67	63.7	20.7	127	120.8	39.2	187	177.8	57.8	247	234.9	76.3
8	07.6	02.5	68	64.7	21.0	128	121.7	39.6	188	178.8	58.1	248	235.9	76.6
9	08.6	02.8	69	65.6	21.3	129	122.7	39.9	189	179.7	58.4	249	236.8	76.9
10	09.5	03.1	70	66.6	21.6	130	123.6	40.2	190	180.7	58.7	250	237.8	77.3
11	10.5	03.4	71	67.5	21.9	131	124.6	40.5	191	181.7	59.0	251	238.7	77.6
12	11.4	03.7	72	68.5	22.2	132	125.5	40.8	192	182.6	59.3	252	239.7	77.9
13	12.4	04.0	73	69.4	22.6	133	126.5	41.1	193	183.6	59.6	253	240.6	78.2
14	13.3	04.3	74	70.4	22.9	134	127.4	41.4	194	184.5	59.9	254	241.6	78.5
15	14.3	04.6	75	71.3	23.2	135	128.4	41.7	195	185.5	60.3	255	242.5	78.8
16	15.2	04.9	76	72.3	23.5	136	129.3	42.0	196	186.4	60.6	256	243.5	79.1
17	16.2	05.3	77	73.2	23.8	137	130.3	42.3	197	187.4	60.9	257	244.4	79.4
18	17.1	05.6	78	74.2	24.1	138	131.2	42.6	198	188.3	61.2	258	245.4	79.7
19	18.1	05.9	79	75.1	24.4	139	132.2	43.0	199	189.3	61.5	259	246.3	80.0
20	19.0	06.2	80	76.1	24.7	140	133.1	43.3	200	190.2	61.8	260	247.3	80.3
21	20.0	06.5	81	77.0	25.0	141	134.1	43.6	201	191.2	62.1	261	248.2	80.7
22	20.9	06.8	82	78.0	25.3	142	135.1	43.9	202	192.1	62.4	262	249.2	81.0
23	21.9	07.1	83	78.9	25.6	143	136.0	44.2	203	193.1	62.7	263	250.1	81.3
24	22.8	07.4	84	79.9	26.0	144	137.0	44.5	204	194.0	63.0	264	251.1	81.6
25	23.8	07.7	85	80.8	26.3	145	137.9	44.8	205	195.0	63.3	265	252.0	81.9
26	24.7	08.0	86	81.8	26.6	146	138.9	45.1	206	195.9	63.7	266	253.0	82.2
27	25.7	08.3	87	82.7	26.9	147	139.8	45.4	207	196.9	64.0	267	253.9	82.5
28	26.6	08.7	88	83.7	27.2	148	140.8	45.7	208	197.8	64.3	268	254.9	82.8
29	27.6	09.0	89	84.6	27.5	149	141.7	46.0	209	198.8	64.6	269	255.8	83.1
30	28.5	09.3	90	85.6	27.8	150	142.7	46.4	210	199.7	64.9	270	256.8	83.4
31	29.5	09.6	91	86.5	28.1	151	143.6	46.7	211	200.7	65.2	271	257.7	83.7
32	30.4	09.9	92	87.5	28.4	152	144.6	47.0	212	201.6	65.5	272	258.7	84.1
33	31.4	10.2	93	88.4	28.7	153	145.5	47.3	213	202.6	65.8	273	259.6	84.4
34	32.3	10.5	94	89.4	29.0	154	146.5	47.6	214	203.5	66.1	274	260.6	84.7
35	33.3	10.8	95	90.4	29.4	155	147.4	47.9	215	204.5	66.4	275	261.5	85.0
36	34.2	11.1	96	91.3	29.7	156	148.4	48.2	216	205.4	66.7	276	262.5	85.3
37	35.2	11.4	97	92.3	30.0	157	149.3	48.5	217	206.4	67.1	277	263.4	85.6
38	36.1	11.7	98	93.2	30.3	158	150.3	48.8	218	207.3	67.4	278	264.4	85.9
39	37.1	12.1	99	94.2	30.6	159	151.2	49.1	219	208.3	67.7	279	265.3	86.2
40	38.0	12.4	100	95.1	30.9	160	152.2	49.4	220	209.2	68.0	280	266.3	86.5
41	39.0	12.7	101	96.1	31.2	161	153.1	49.8	221	210.2	68.3	281	267.2	86.8
42	39.9	13.0	102	97.0	31.5	162	154.1	50.1	222	211.1	68.6	282	268.2	87.1
43	40.9	13.3	103	98.0	31.8	163	155.0	50.4	223	212.1	68.9	283	269.1	87.5
44	41.8	13.6	104	98.9	32.1	164	156.0	50.7	224	213.0	69.2	284	270.1	87.8
45	42.8	13.9	105	99.9	32.4	165	156.9	51.0	225	214.0	69.5	285	271.1	88.1
46	43.7	14.2	106	100.8	32.8	166	157.9	51.3	226	214.9	69.8	286	272.0	88.4
47	44.7	14.5	107	101.8	33.1	167	158.8	51.6	227	215.9	70.1	287	273.0	88.7
48	45.7	14.8	108	102.7	33.4	168	159.8	51.9	228	216.8	70.5	288	273.9	89.0
49	46.6	15.1	109	103.7	33.7	169	160.7	52.2	229	217.8	70.8	289	274.9	89.3
50	47.6	15.5	110	104.6	34.0	170	161.7	52.5	230	218.7	71.1	290	275.8	89.6
51	48.5	15.8	111	105.6	34.3	171	162.6	52.8	231	219.7	71.4	291	276.8	89.9
52	49.5	16.1	112	106.5	34.6	172	163.6	53.2	232	220.6	71.7	292	277.7	90.2
53	50.4	16.4	113	107.5	34.9	173	164.5	53.5	233	221.6	72.0	293	278.7	90.5
54	51.4	16.7	114	108.4	35.2	174	165.5	53.8	234	222.5	72.3	294	279.6	90.9
55	52.3	17.0	115	109.4	35.5	175	166.4	54.1	235	223.5	72.6	295	280.6	91.2
56	53.3	17.3	116	110.3	35.8	176	167.4	54.4	236	224.4	72.9	296	281.5	91.5
57	54.2	17.6	117	111.3	36.2	177	168.3	54.7	237	225.4	73.2	297	282.5	91.8
58	55.2	17.9	118	112.2	36.5	178	169.3	55.0	238	226.4	73.5	298	283.4	92.1
59	56.1	18.2	119	113.2	36.8	179	170.2	55.3	239	227.3	73.9	299	284.4	92.4
60	57.1	18.5	120	114.1	37.1	180	171.2	55.6	240	228.3	74.2	300	285.3	92.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 72 Degrees.

TABLE II.

Difference of Latitude and Departure for 19 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.3	61	57.7	19.9	121	114.4	39.4	181	171.1	58.9	241	227.9	78.5
2	01.9	00.7	62	58.6	20.2	122	115.4	39.7	182	172.1	59.3	242	228.8	78.8
3	02.8	01.0	63	59.6	20.5	123	116.3	40.0	183	173.0	59.6	243	229.8	79.1
4	03.8	01.3	64	60.5	20.8	124	117.2	40.4	184	174.0	59.9	244	230.7	79.4
5	04.7	01.6	65	61.5	21.2	125	118.2	40.7	185	174.9	60.2	245	231.7	79.8
6	05.7	02.0	66	62.4	21.5	126	119.1	41.0	186	175.9	60.6	246	232.6	80.1
7	06.6	02.3	67	63.3	21.8	127	120.1	41.3	187	176.8	60.9	247	233.5	80.4
8	07.6	02.6	68	64.3	22.1	128	121.0	41.7	188	177.8	61.2	248	234.5	80.7
9	08.5	02.9	69	65.2	22.5	129	122.0	42.0	189	178.7	61.5	249	235.4	81.1
10	09.5	03.3	70	66.2	22.8	130	122.9	42.3	190	179.6	61.9	250	236.4	81.4
11	10.4	03.6	71	67.1	23.1	131	123.9	42.6	191	180.6	62.2	251	237.3	81.7
12	11.3	03.9	72	68.1	23.4	132	124.8	43.0	192	181.5	62.5	252	238.3	82.0
13	12.3	04.2	73	69.0	23.8	133	125.8	43.3	193	182.5	62.8	253	239.2	82.4
14	13.2	04.6	74	70.0	24.1	134	126.7	43.6	194	183.4	63.2	254	240.2	82.7
15	14.2	04.9	75	70.9	24.4	135	127.6	44.0	195	184.4	63.5	255	241.1	83.0
16	15.1	05.2	76	71.9	24.7	136	128.6	44.3	196	185.3	63.8	256	242.1	83.3
17	16.1	05.5	77	72.8	25.1	137	129.5	44.6	197	186.3	64.1	257	243.0	83.7
18	17.0	05.9	78	73.8	25.4	138	130.5	44.9	198	187.2	64.5	258	243.9	84.0
19	18.0	06.2	79	74.7	25.7	139	131.4	45.3	199	188.2	64.8	259	244.9	84.3
20	18.9	06.5	80	75.6	26.0	140	132.4	45.6	200	189.1	65.1	260	245.8	84.6
21	19.9	06.8	81	76.6	26.4	141	133.3	45.9	201	190.0	65.4	261	246.8	85.0
22	20.8	07.2	82	77.5	26.7	142	134.3	46.2	202	191.0	65.8	262	247.7	85.3
23	21.7	07.5	83	78.5	27.0	143	135.2	46.6	203	191.9	66.1	263	248.7	85.6
24	22.7	07.8	84	79.4	27.3	144	136.2	46.9	204	192.9	66.4	264	249.6	86.0
25	23.6	08.1	85	80.4	27.7	145	137.1	47.2	205	193.8	66.7	265	250.6	86.3
26	24.6	08.5	86	81.3	28.0	146	138.0	47.5	206	194.8	67.1	266	251.5	86.6
27	25.5	08.8	87	82.3	28.3	147	139.0	47.9	207	195.7	67.4	267	252.5	86.9
28	26.5	09.1	88	83.2	28.7	148	139.9	48.2	208	196.7	67.7	268	253.4	87.3
29	27.4	09.4	89	84.2	29.0	149	140.9	48.5	209	197.6	68.0	269	254.3	87.6
30	28.4	09.8	90	85.1	29.3	150	141.8	48.8	210	198.6	68.4	270	255.3	87.9
31	29.3	10.1	91	86.0	29.6	151	142.8	49.2	211	199.5	68.7	271	256.2	88.2
32	30.3	10.4	92	87.0	30.0	152	143.7	49.5	212	200.4	69.0	272	257.2	88.6
33	31.2	10.7	93	87.9	30.3	153	144.7	49.8	213	201.4	69.3	273	258.1	88.9
34	32.1	11.1	94	88.9	30.6	154	145.6	50.1	214	202.3	69.7	274	259.1	89.2
35	33.1	11.4	95	89.8	30.9	155	146.6	50.5	215	203.3	70.0	275	260.0	89.5
36	34.0	11.7	96	90.8	31.3	156	147.5	50.8	216	204.2	70.3	276	261.0	89.9
37	35.0	12.0	97	91.7	31.6	157	148.4	51.1	217	205.2	70.6	277	261.9	90.2
38	35.9	12.4	98	92.7	31.9	158	149.4	51.4	218	206.1	71.0	278	262.9	90.5
39	36.9	12.7	99	93.6	32.2	159	150.3	51.8	219	207.1	71.3	279	263.8	90.8
40	37.8	13.0	100	94.6	32.6	160	151.3	52.1	220	208.0	71.6	280	264.7	91.2
41	38.8	13.3	101	95.5	32.9	161	152.2	52.4	221	209.0	72.0	281	265.7	91.5
42	39.7	13.7	102	96.4	33.2	162	153.2	52.7	222	209.9	72.3	282	266.6	91.8
43	40.7	14.0	103	97.4	33.5	163	154.1	53.1	223	210.9	72.6	283	267.6	92.1
44	41.6	14.3	104	98.3	33.9	164	155.1	53.4	224	211.8	72.9	284	268.5	92.5
45	42.5	14.7	105	99.3	34.2	165	156.0	53.7	225	212.7	73.3	285	269.5	92.8
46	43.5	15.0	106	100.2	34.5	166	157.0	54.0	226	213.7	73.6	286	270.4	93.1
47	44.4	15.3	107	101.2	34.8	167	157.9	54.4	227	214.6	73.9	287	271.4	93.4
48	45.4	15.6	108	102.1	35.2	168	158.8	54.7	228	215.6	74.2	288	272.3	93.8
49	46.3	16.0	109	103.1	35.5	169	159.8	55.0	229	216.5	74.6	289	273.3	94.1
50	47.3	16.3	110	104.0	35.8	170	160.7	55.3	230	217.5	74.9	290	274.2	94.4
51	48.2	16.6	111	105.0	36.1	171	161.7	55.7	231	218.4	75.2	291	275.1	94.7
52	49.2	16.9	112	105.9	36.5	172	162.6	56.0	232	219.4	75.5	292	276.1	95.1
53	50.1	17.3	113	106.8	36.8	173	163.6	56.3	233	220.3	75.9	293	277.0	95.4
54	51.1	17.6	114	107.8	37.1	174	164.5	56.6	234	221.3	76.2	294	278.0	95.7
55	52.0	17.9	115	108.7	37.4	175	165.5	57.0	235	222.2	76.5	295	278.9	96.0
56	52.9	18.2	116	109.7	37.8	176	166.4	57.3	236	223.1	76.8	296	279.9	96.4
57	53.9	18.6	117	110.6	38.1	177	167.4	57.6	237	224.1	77.2	297	280.8	96.7
58	54.8	18.9	118	111.6	38.4	178	168.3	58.0	238	225.0	77.5	298	281.8	97.0
59	55.8	19.2	119	112.5	38.7	179	169.2	58.3	239	226.0	77.8	299	282.7	97.3
60	56.7	19.5	120	113.5	39.1	180	170.2	58.6	240	226.9	78.1	300	283.7	97.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 71 Degrees.

TABLE II.

Difference of Latitude and Departure for 20 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.3	61	57.3	20.9	121	113.7	41.4	181	170.1	61.9	241	226.5	82.4
2	01.9	00.7	62	58.3	21.2	122	114.6	41.7	182	171.0	62.2	242	227.4	82.8
3	02.8	01.0	63	59.2	21.5	123	115.6	42.1	183	172.0	62.6	243	228.3	83.1
4	03.8	01.4	64	60.1	21.9	124	116.5	42.4	184	172.9	62.9	244	229.3	83.5
5	04.7	01.7	65	61.1	22.2	125	117.5	42.8	185	173.8	63.3	245	230.2	83.8
6	05.6	02.1	66	62.0	22.6	126	118.4	43.1	186	174.8	63.6	246	231.2	84.1
7	06.6	02.4	67	63.0	22.9	127	119.3	43.4	187	175.7	64.0	247	232.1	84.5
8	07.5	02.7	68	63.9	23.3	128	120.3	43.8	188	176.7	64.3	248	233.0	84.8
9	08.5	03.1	69	64.8	23.6	129	121.2	44.1	189	177.6	64.6	249	234.0	85.2
10	09.4	03.4	70	65.8	23.9	130	122.2	44.5	190	178.5	65.0	250	234.9	85.5
11	10.3	03.8	71	66.7	24.3	131	123.1	44.8	191	179.5	65.3	251	235.9	85.8
12	11.3	04.1	72	67.7	24.6	132	124.0	45.1	192	180.4	65.7	252	236.8	86.2
13	12.2	04.4	73	68.6	25.0	133	125.0	45.5	193	181.4	66.0	253	237.7	86.5
14	13.2	04.8	74	69.5	25.3	134	125.9	45.8	194	182.3	66.4	254	238.7	86.9
15	14.1	05.1	75	70.5	25.7	135	126.9	46.2	195	183.2	66.7	255	239.6	87.2
16	15.0	05.5	76	71.4	26.0	136	127.8	46.5	196	184.2	67.0	256	240.6	87.6
17	16.0	05.8	77	72.4	26.3	137	128.7	46.9	197	185.1	67.4	257	241.5	87.9
18	16.9	06.2	78	73.3	26.7	138	129.7	47.2	198	186.1	67.7	258	242.4	88.2
19	17.9	06.5	79	74.2	27.0	139	130.6	47.5	199	187.0	68.1	259	243.4	88.6
20	18.8	06.8	80	75.2	27.4	140	131.6	47.9	200	187.9	68.4	260	244.3	88.9
21	19.7	07.2	81	76.1	27.7	141	132.5	48.2	201	188.9	68.7	261	245.3	89.3
22	20.7	07.5	82	77.1	28.0	142	133.4	48.6	202	189.8	69.1	262	246.2	89.6
23	21.6	07.9	83	78.0	28.4	143	134.4	48.9	203	190.8	69.4	263	247.1	90.0
24	22.6	08.2	84	78.9	28.7	144	135.3	49.3	204	191.7	69.8	264	248.1	90.3
25	23.5	08.6	85	79.9	29.1	145	136.3	49.6	205	192.6	70.1	265	249.0	90.6
26	24.4	08.9	86	80.8	29.4	146	137.2	49.9	206	193.6	70.5	266	250.0	91.0
27	25.4	09.2	87	81.8	29.8	147	138.1	50.3	207	194.5	70.8	267	250.9	91.3
28	26.3	09.6	88	82.7	30.1	148	139.1	50.6	208	195.5	71.1	268	251.8	91.7
29	27.3	09.9	89	83.6	30.4	149	140.0	51.0	209	196.4	71.5	269	252.8	92.0
30	28.2	10.3	90	84.6	30.8	150	141.0	51.3	210	197.3	71.8	270	253.7	92.3
31	29.1	10.6	91	85.5	31.1	151	141.9	51.6	211	198.3	72.2	271	254.7	92.7
32	30.1	10.9	92	86.5	31.5	152	142.8	52.0	212	199.2	72.5	272	255.6	93.0
33	31.0	11.3	93	87.4	31.8	153	143.8	52.3	213	200.2	72.9	273	256.5	93.4
34	31.9	11.6	94	88.3	32.1	154	144.7	52.7	214	201.1	73.2	274	257.5	93.7
35	32.9	12.0	95	89.3	32.5	155	145.7	53.0	215	202.0	73.5	275	258.4	94.1
36	33.8	12.3	96	90.2	32.8	156	146.6	53.4	216	203.0	73.9	276	259.4	94.4
37	34.8	12.7	97	91.2	33.2	157	147.5	53.7	217	203.9	74.2	277	260.3	94.7
38	35.7	13.0	98	92.1	33.5	158	148.5	54.0	218	204.9	74.6	278	261.2	95.1
39	36.6	13.3	99	93.0	33.9	159	149.4	54.4	219	205.8	74.9	279	262.2	95.4
40	37.6	13.7	100	94.0	34.2	160	150.4	54.7	220	206.7	75.2	280	263.1	95.8
41	38.5	14.0	101	94.9	34.5	161	151.3	55.1	221	207.7	75.6	281	264.1	96.1
42	39.5	14.4	102	95.8	34.9	162	152.2	55.4	222	208.6	75.9	282	265.0	96.4
43	40.4	14.7	103	96.8	35.2	163	153.2	55.7	223	209.6	76.3	283	265.9	96.8
44	41.3	15.0	104	97.7	35.6	164	154.1	56.1	224	210.5	76.6	284	266.9	97.1
45	42.3	15.4	105	98.7	35.9	165	155.0	56.4	225	211.4	77.0	285	267.8	97.5
46	43.2	15.7	106	99.6	36.3	166	156.0	56.8	226	212.4	77.3	286	268.8	97.8
47	44.2	16.1	107	100.5	36.6	167	156.9	57.1	227	213.3	77.6	287	269.7	98.2
48	45.1	16.4	108	101.5	36.9	168	157.9	57.5	228	214.2	78.0	288	270.6	98.5
49	46.0	16.8	109	102.4	37.3	169	158.8	57.8	229	215.2	78.3	289	271.6	98.8
50	47.0	17.1	110	103.4	37.6	170	159.7	58.1	230	216.1	78.7	290	272.5	99.2
51	47.9	17.4	111	104.3	38.0	171	160.7	58.5	231	217.1	79.0	291	273.5	99.5
52	48.9	17.8	112	105.2	38.3	172	161.6	58.8	232	218.0	79.3	292	274.4	99.9
53	49.8	18.1	113	106.2	38.6	173	162.6	59.2	233	218.9	79.7	293	275.3	100.2
54	50.7	18.5	114	107.1	39.0	174	163.5	59.5	234	219.9	80.0	294	276.3	100.6
55	51.7	18.8	115	108.1	39.3	175	164.4	59.9	235	220.8	80.4	295	277.2	100.9
56	52.6	19.2	116	109.0	39.7	176	165.4	60.2	236	221.8	80.7	296	278.1	101.2
57	53.6	19.5	117	109.9	40.0	177	166.3	60.5	237	222.7	81.1	297	279.1	101.6
58	54.5	19.8	118	110.9	40.4	178	167.3	60.9	238	223.6	81.4	298	280.0	101.9
59	55.4	20.2	119	111.8	40.7	179	168.2	61.2	239	224.6	81.7	299	281.0	102.3
60	56.4	20.5	120	112.8	41.0	180	169.1	61.6	240	225.5	82.1	300	281.9	102.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 70 Degrees.

TABLE II.

Difference of Latitude and Departure for 21 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	56.9	21.9	121	113.0	43.4	181	169.0	64.9	241	225.0	86.4
2	01.9	00.7	62	57.9	22.2	122	113.9	43.7	182	169.9	65.2	242	225.9	86.7
3	02.8	01.1	63	58.8	22.6	123	114.8	44.1	183	170.8	65.6	243	226.9	87.1
4	03.7	01.4	64	59.7	22.9	124	115.8	44.4	184	171.8	65.9	244	227.8	87.4
5	04.7	01.8	65	60.7	23.3	125	116.7	44.8	185	172.7	66.3	245	228.7	87.8
6	05.6	02.2	66	61.6	23.7	126	117.6	45.2	186	173.6	66.7	246	229.7	88.2
7	06.5	02.5	67	62.5	24.0	127	118.6	45.5	187	174.6	67.0	247	230.6	88.5
8	07.5	02.9	68	63.5	24.4	128	119.5	45.9	188	175.5	67.4	248	231.5	88.9
9	08.4	03.2	69	64.4	24.7	129	120.4	46.2	189	176.4	67.7	249	232.5	89.2
10	09.3	03.6	70	65.4	25.1	130	121.4	46.6	190	177.4	68.1	250	233.4	89.6
11	10.3	03.9	71	66.3	25.4	131	122.3	46.9	191	178.3	68.4	251	234.3	90.0
12	11.2	04.3	72	67.2	25.8	132	123.2	47.3	192	179.2	68.8	252	235.3	90.3
13	12.1	04.7	73	68.2	26.2	133	124.2	47.7	193	180.2	69.2	253	236.2	90.7
14	13.1	05.0	74	69.1	26.5	134	125.1	48.0	194	181.1	69.5	254	237.1	91.0
15	14.0	05.4	75	70.0	26.9	135	126.0	48.4	195	182.0	69.9	255	238.1	91.4
16	14.9	05.7	76	71.0	27.2	136	127.0	48.7	196	183.0	70.2	256	239.0	91.7
17	15.9	06.1	77	71.9	27.6	137	127.9	49.1	197	183.9	70.6	257	239.9	92.1
18	16.8	06.5	78	72.8	28.0	138	128.8	49.5	198	184.8	71.0	258	240.9	92.5
19	17.7	06.8	79	73.8	28.3	139	129.8	49.8	199	185.8	71.3	259	241.8	92.8
20	18.7	07.2	80	74.7	28.7	140	130.7	50.2	200	186.7	71.7	260	242.7	93.2
21	19.6	07.5	81	75.6	29.0	141	131.6	50.5	201	187.6	72.0	261	243.7	93.5
22	20.5	07.9	82	76.6	29.4	142	132.6	50.9	202	188.6	72.4	262	244.6	93.9
23	21.5	08.2	83	77.5	29.7	143	133.5	51.2	203	189.5	72.7	263	245.5	94.3
24	22.4	08.6	84	78.4	30.1	144	134.4	51.6	204	190.4	73.1	264	246.5	94.6
25	23.3	09.0	85	79.4	30.5	145	135.4	52.0	205	191.4	73.5	265	247.4	95.0
26	24.3	09.3	86	80.3	30.8	146	136.3	52.3	206	192.3	73.8	266	248.3	95.3
27	25.2	09.7	87	81.2	31.2	147	137.2	52.7	207	193.3	74.2	267	249.3	95.7
28	26.1	10.0	88	82.2	31.5	148	138.2	53.0	208	194.2	74.5	268	250.2	96.0
29	27.1	10.4	89	83.1	31.9	149	139.1	53.4	209	195.1	74.9	269	251.1	96.4
30	28.0	10.8	90	84.0	32.3	150	140.0	53.8	210	196.1	75.3	270	252.1	96.8
31	28.9	11.1	91	85.0	32.6	151	141.0	54.1	211	197.0	75.6	271	253.0	97.1
32	29.9	11.5	92	85.9	33.0	152	141.9	54.5	212	197.9	76.0	272	253.9	97.5
33	30.8	11.8	93	86.8	33.3	153	142.8	54.8	213	198.9	76.3	273	254.9	97.8
34	31.7	12.2	94	87.8	33.7	154	143.8	55.2	214	199.8	76.7	274	255.8	98.2
35	32.7	12.5	95	88.7	34.0	155	144.7	55.5	215	200.7	77.0	275	256.7	98.6
36	33.6	12.9	96	89.6	34.4	156	145.6	55.9	216	201.7	77.4	276	257.7	98.9
37	34.5	13.3	97	90.6	34.8	157	146.6	56.3	217	202.6	77.8	277	258.6	99.3
38	35.5	13.6	98	91.5	35.1	158	147.5	56.6	218	203.5	78.1	278	259.5	99.6
39	36.4	14.0	99	92.4	35.5	159	148.4	57.0	219	204.5	78.5	279	260.5	100.0
40	37.3	14.3	100	93.4	35.8	160	149.4	57.3	220	205.4	78.8	280	261.4	100.3
41	38.3	14.7	101	94.3	36.2	161	150.3	57.7	221	206.3	79.2	281	262.3	100.7
42	39.2	15.1	102	95.2	36.6	162	151.2	58.1	222	207.3	79.6	282	263.3	101.1
43	40.1	15.4	103	96.2	36.9	163	152.2	58.4	223	208.2	79.9	283	264.2	101.4
44	41.1	15.8	104	97.1	37.3	164	153.1	58.8	224	209.1	80.3	284	265.1	101.8
45	42.0	16.1	105	98.0	37.6	165	154.0	59.1	225	210.1	80.6	285	266.1	102.1
46	42.9	16.5	106	99.0	38.0	166	155.0	59.5	226	211.0	81.0	286	267.0	102.5
47	43.9	16.8	107	99.9	38.3	167	155.9	59.8	227	211.9	81.3	287	267.9	102.9
48	44.8	17.2	108	100.8	38.7	168	156.8	60.2	228	212.9	81.7	288	268.9	103.2
49	45.7	17.6	109	101.8	39.1	169	157.8	60.6	229	213.8	82.1	289	269.8	103.6
50	46.7	17.9	110	102.7	39.4	170	158.7	60.9	230	214.7	82.4	290	270.7	103.9
51	47.6	18.3	111	103.6	39.8	171	159.6	61.3	231	215.7	82.8	291	271.7	104.3
52	48.5	18.6	112	104.6	40.1	172	160.6	61.6	232	216.6	83.1	292	272.6	104.6
53	49.5	19.0	113	105.5	40.5	173	161.5	62.0	233	217.5	83.5	293	273.5	105.0
54	50.4	19.4	114	106.4	40.9	174	162.4	62.4	234	218.5	83.9	294	274.5	105.4
55	51.3	19.7	115	107.4	41.2	175	163.4	62.7	235	219.4	84.2	295	275.4	105.7
56	52.3	20.1	116	108.3	41.6	176	164.3	63.1	236	220.3	84.6	296	276.3	106.1
57	53.2	20.4	117	109.2	41.9	177	165.2	63.4	237	221.3	84.9	297	277.3	106.4
58	54.1	20.8	118	110.2	42.3	178	166.2	63.8	238	222.2	85.3	298	278.2	106.8
59	55.1	21.1	119	111.1	42.6	179	167.1	64.1	239	223.1	85.6	299	279.1	107.2
60	56.0	21.5	120	112.0	43.0	180	168.0	64.5	240	224.1	86.0	300	280.1	107.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 69 Degrees.

TABLE II.

Difference of Latitude and Departure for 22 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	56.6	22.9	121	112.2	45.3	181	167.8	67.8	241	223.5	90.3
2	01.9	00.7	62	57.5	23.2	122	113.1	45.7	182	168.7	68.2	242	224.4	90.7
3	02.8	01.1	63	58.4	23.6	123	114.0	46.1	183	169.7	68.6	243	225.3	91.0
4	03.7	01.5	64	59.3	24.0	124	115.0	46.5	184	170.6	68.9	244	226.2	91.4
5	04.6	01.9	65	60.3	24.3	125	115.9	46.8	185	171.5	69.3	245	227.2	91.8
6	05.6	02.2	66	61.2	24.7	126	116.8	47.2	186	172.5	69.7	246	228.1	92.2
7	06.5	02.6	67	62.1	25.1	127	117.8	47.6	187	173.4	70.1	247	229.0	92.5
8	07.4	03.0	68	63.0	25.5	128	118.7	47.9	188	174.3	70.4	248	229.9	92.9
9	08.3	03.4	69	64.0	25.8	129	119.6	48.3	189	175.2	70.8	249	230.9	93.3
10	09.3	03.7	70	64.9	26.2	130	120.5	48.7	190	176.2	71.2	250	231.8	93.7
11	10.2	04.1	71	65.8	26.6	131	121.5	49.1	191	177.1	71.5	251	232.7	94.0
12	11.1	04.5	72	66.8	27.0	132	122.4	49.4	192	178.0	71.9	252	233.7	94.4
13	12.1	04.9	73	67.7	27.3	133	123.3	49.8	193	178.9	72.3	253	234.6	94.8
14	13.0	05.2	74	68.6	27.7	134	124.2	50.2	194	179.9	72.7	254	235.5	95.2
15	13.9	05.6	75	69.5	28.1	135	125.2	50.6	195	180.8	73.0	255	236.4	95.5
16	14.8	06.0	76	70.5	28.5	136	126.1	50.9	196	181.7	73.4	256	237.4	95.9
17	15.8	06.4	77	71.4	28.8	137	127.0	51.3	197	182.7	73.8	257	238.3	96.3
18	16.7	06.7	78	72.3	29.2	138	128.0	51.7	198	183.6	74.2	258	239.2	96.6
19	17.6	07.1	79	73.2	29.6	139	128.9	52.1	199	184.5	74.5	259	240.1	97.0
20	18.5	07.5	80	74.2	30.0	140	129.8	52.4	200	185.4	74.9	260	241.1	97.4
21	19.5	07.9	81	75.1	30.3	141	130.7	52.8	201	186.4	75.3	261	242.0	97.8
22	20.4	08.2	82	76.0	30.7	142	131.7	53.2	202	187.3	75.7	262	242.9	98.1
23	21.3	08.6	83	77.0	31.1	143	132.6	53.6	203	188.2	76.0	263	243.8	98.5
24	22.3	09.0	84	77.9	31.5	144	133.5	53.9	204	189.1	76.4	264	244.8	98.9
25	23.2	09.4	85	78.8	31.8	145	134.4	54.3	205	190.1	76.8	265	245.7	99.3
26	24.1	09.7	86	79.7	32.2	146	135.4	54.7	206	191.0	77.2	266	246.6	99.6
27	25.0	10.1	87	80.7	32.6	147	136.3	55.1	207	191.9	77.5	267	247.6	100.0
28	26.0	10.5	88	81.6	33.0	148	137.2	55.4	208	192.9	77.9	268	248.5	100.4
29	26.9	10.9	89	82.5	33.3	149	138.2	55.8	209	193.8	78.3	269	249.4	100.8
30	27.8	11.2	90	83.4	33.7	150	139.1	56.2	210	194.7	78.7	270	250.3	101.1
31	28.7	11.6	91	84.4	34.1	151	140.0	56.6	211	195.6	79.0	271	251.3	101.5
32	29.7	12.0	92	85.3	34.5	152	140.9	56.9	212	196.6	79.4	272	252.2	101.9
33	30.6	12.4	93	86.2	34.8	153	141.9	57.3	213	197.5	79.8	273	253.1	102.3
34	31.5	12.7	94	87.2	35.2	154	142.8	57.7	214	198.4	80.2	274	254.0	102.6
35	32.5	13.1	95	88.1	35.6	155	143.7	58.1	215	199.3	80.5	275	255.0	103.0
36	33.4	13.5	96	89.0	36.0	156	144.6	58.4	216	200.3	80.9	276	255.9	103.4
37	34.3	13.9	97	89.9	36.3	157	145.6	58.8	217	201.2	81.3	277	256.8	103.8
38	35.2	14.2	98	90.9	36.7	158	146.5	59.2	218	202.1	81.7	278	257.8	104.1
39	36.2	14.6	99	91.8	37.1	159	147.4	59.6	219	203.1	82.0	279	258.7	104.5
40	37.1	15.0	100	92.7	37.5	160	148.3	59.9	220	204.0	82.4	280	259.6	104.9
41	38.0	15.4	101	93.6	37.8	161	149.3	60.3	221	204.9	82.8	281	260.5	105.3
42	38.9	15.7	102	94.6	38.2	162	150.2	60.7	222	205.8	83.2	282	261.5	105.6
43	39.9	16.1	103	95.5	38.6	163	151.1	61.1	223	206.8	83.5	283	262.4	106.0
44	40.8	16.5	104	96.4	39.0	164	152.1	61.4	224	207.7	83.9	284	263.3	106.4
45	41.7	16.9	105	97.4	39.3	165	153.0	61.8	225	208.6	84.3	285	264.2	106.8
46	42.7	17.2	106	98.3	39.7	166	153.9	62.2	226	209.5	84.7	286	265.2	107.1
47	43.6	17.6	107	99.2	40.1	167	154.8	62.6	227	210.5	85.0	287	266.1	107.5
48	44.5	18.0	108	100.1	40.5	168	155.8	62.9	228	211.4	85.4	288	267.0	107.9
49	45.4	18.4	109	101.1	40.8	169	156.7	63.3	229	212.3	85.8	289	268.0	108.3
50	46.4	18.7	110	102.0	41.2	170	157.6	63.7	230	213.3	86.2	290	268.9	108.6
51	47.3	19.1	111	102.9	41.6	171	158.5	64.1	231	214.2	86.5	291	269.8	109.0
52	48.2	19.5	112	103.8	42.0	172	159.5	64.4	232	215.1	86.9	292	270.7	109.4
53	49.1	19.9	113	104.8	42.3	173	160.4	64.8	233	216.0	87.3	293	271.7	109.8
54	50.1	20.2	114	105.7	42.7	174	161.3	65.2	234	217.0	87.7	294	272.6	110.1
55	51.0	20.6	115	106.6	43.1	175	162.3	65.6	235	217.9	88.0	295	273.5	110.5
56	51.9	21.0	116	107.6	43.5	176	163.2	65.9	236	218.8	88.4	296	274.4	110.9
57	52.8	21.4	117	108.5	43.8	177	164.1	66.3	237	219.7	88.8	297	275.4	111.3
58	53.8	21.7	118	109.4	44.2	178	165.0	66.7	238	220.7	89.2	298	276.3	111.6
59	54.7	22.1	119	110.3	44.6	179	166.0	67.1	239	221.6	89.5	299	277.2	112.0
60	55.6	22.5	120	111.3	45.0	180	166.9	67.4	240	222.5	89.9	300	278.2	112.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 68 Degrees.

TABLE II.

Difference of Latitude and Departure for 23 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	56.2	23.8	121	111.4	47.3	181	166.6	70.7	241	221.8	94.2
2	01.8	00.8	62	57.1	24.2	122	112.3	47.7	182	167.5	71.1	242	222.8	94.6
3	02.8	01.2	63	58.0	24.6	123	113.2	48.1	183	168.5	71.5	243	223.7	94.9
4	03.7	01.6	64	58.9	25.0	124	114.1	48.5	184	169.4	71.9	244	224.6	95.3
5	04.6	02.0	65	59.8	25.4	125	115.1	48.8	185	170.3	72.3	245	225.5	95.7
6	05.5	02.3	66	60.8	25.8	126	116.0	49.2	186	171.2	72.7	246	226.4	96.1
7	06.4	02.7	67	61.7	26.2	127	116.9	49.6	187	172.1	73.1	247	227.4	96.5
8	07.4	03.1	68	62.6	26.6	128	117.8	50.0	188	173.1	73.5	248	228.3	96.9
9	08.3	03.5	69	63.5	27.0	129	118.7	50.4	189	174.0	73.8	249	229.2	97.3
10	09.2	03.9	70	64.4	27.4	130	119.7	50.8	190	174.9	74.2	250	230.1	97.7
11	10.1	04.3	71	65.4	27.7	131	120.6	51.2	191	175.8	74.6	251	231.0	98.1
12	11.0	04.7	72	66.3	28.1	132	121.5	51.6	192	176.7	75.0	252	232.0	98.5
13	12.0	05.1	73	67.2	28.5	133	122.4	52.0	193	177.7	75.4	253	232.9	98.9
14	12.9	05.5	74	68.1	28.9	134	123.3	52.4	194	178.6	75.8	254	233.8	99.2
15	13.8	05.9	75	69.0	29.3	135	124.3	52.7	195	179.5	76.2	255	234.7	99.6
16	14.7	06.3	76	70.0	29.7	136	125.2	53.1	196	180.4	76.6	256	235.6	100.0
17	15.6	06.6	77	70.9	30.1	137	126.1	53.5	197	181.3	77.0	257	236.6	100.4
18	16.6	07.0	78	71.8	30.5	138	127.0	53.9	198	182.3	77.4	258	237.5	100.8
19	17.5	07.4	79	72.7	30.9	139	128.0	54.3	199	183.2	77.8	259	238.4	101.2
20	18.4	07.8	80	73.6	31.3	140	128.9	54.7	200	184.1	78.1	260	239.3	101.6
21	19.3	08.2	81	74.6	31.6	141	129.8	55.1	201	185.0	78.5	261	240.3	102.0
22	20.3	08.6	82	75.5	32.0	142	130.7	55.5	202	185.9	78.9	262	241.2	102.4
23	21.2	09.0	83	76.4	32.4	143	131.6	55.9	203	186.9	79.3	263	242.1	102.8
24	22.1	09.4	84	77.3	32.8	144	132.6	56.3	204	187.8	79.7	264	243.0	103.2
25	23.0	09.8	85	78.2	33.2	145	133.5	56.7	205	188.7	80.1	265	243.9	103.5
26	23.9	10.2	86	79.2	33.6	146	134.4	57.0	206	189.6	80.5	266	244.9	103.9
27	24.9	10.5	87	80.1	34.0	147	135.3	57.4	207	190.5	80.9	267	245.8	104.3
28	25.8	10.9	88	81.0	34.4	148	136.2	57.8	208	191.5	81.3	268	246.7	104.7
29	26.7	11.3	89	81.9	34.8	149	137.2	58.2	209	192.4	81.7	269	247.6	105.1
30	27.6	11.7	90	82.8	35.2	150	138.1	58.6	210	193.3	82.1	270	248.5	105.5
31	28.5	12.1	91	83.8	35.6	151	139.0	59.0	211	194.2	82.4	271	249.5	105.9
32	29.5	12.5	92	84.7	35.9	152	139.9	59.4	212	195.1	82.8	272	250.4	106.3
33	30.4	12.9	93	85.6	36.3	153	140.8	59.8	213	196.1	83.2	273	251.3	106.7
34	31.3	13.3	94	86.5	36.7	154	141.8	60.2	214	197.0	83.6	274	252.2	107.1
35	32.2	13.7	95	87.4	37.1	155	142.7	60.6	215	197.9	84.0	275	253.1	107.5
36	33.1	14.1	96	88.4	37.5	156	143.6	61.0	216	198.8	84.4	276	254.1	107.8
37	34.1	14.5	97	89.3	37.9	157	144.5	61.3	217	199.7	84.8	277	255.0	108.2
38	35.0	14.8	98	90.2	38.3	158	145.4	61.7	218	200.7	85.2	278	255.9	108.6
39	35.9	15.2	99	91.1	38.7	159	146.4	62.1	219	201.6	85.6	279	256.8	109.0
40	36.8	15.6	100	92.1	39.1	160	147.3	62.5	220	202.5	86.0	280	257.7	109.4
41	37.7	16.0	101	93.0	39.5	161	148.2	62.9	221	203.4	86.4	281	258.7	109.8
42	38.7	16.4	102	93.9	39.9	162	149.1	63.3	222	204.4	86.7	282	259.6	110.2
43	39.6	16.8	103	94.8	40.2	163	150.0	63.7	223	205.3	87.1	283	260.5	110.6
44	40.5	17.2	104	95.7	40.6	164	151.0	64.1	224	206.2	87.5	284	261.4	111.0
45	41.4	17.6	105	96.7	41.0	165	151.9	64.5	225	207.1	87.9	285	262.3	111.4
46	42.3	18.0	106	97.6	41.4	166	152.8	64.9	226	208.0	88.3	286	263.3	111.7
47	43.3	18.4	107	98.5	41.8	167	153.7	65.3	227	209.0	88.7	287	264.2	112.1
48	44.2	18.8	108	99.4	42.2	168	154.6	65.6	228	209.9	89.1	288	265.1	112.5
49	45.1	19.1	109	100.3	42.6	169	155.6	66.0	229	210.8	89.5	289	266.0	112.9
50	46.0	19.5	110	101.3	43.0	170	156.5	66.4	230	211.7	89.9	290	266.9	113.3
51	46.9	19.9	111	102.2	43.4	171	157.4	66.8	231	212.6	90.3	291	267.9	113.7
52	47.9	20.3	112	103.1	43.8	172	158.3	67.2	232	213.6	90.6	292	268.8	114.1
53	48.8	20.7	113	104.0	44.2	173	159.2	67.6	233	214.5	91.0	293	269.7	114.5
54	49.7	21.1	114	104.9	44.5	174	160.2	68.0	234	215.4	91.4	294	270.6	114.9
55	50.6	21.5	115	105.9	44.9	175	161.1	68.4	235	216.3	91.8	295	271.5	115.3
56	51.5	21.9	116	106.8	45.3	176	162.0	68.8	236	217.2	92.2	296	272.5	115.7
57	52.5	22.3	117	107.7	45.7	177	162.9	69.2	237	218.2	92.6	297	273.4	116.0
58	53.4	22.7	118	108.6	46.1	178	163.8	69.6	238	219.1	93.0	298	274.3	116.4
59	54.3	23.1	119	109.5	46.5	179	164.8	69.9	239	220.0	93.4	299	275.2	116.8
60	55.2	23.4	120	110.5	46.9	180	165.7	70.3	240	220.9	93.8	300	276.2	117.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 67 Degrees.

TABLE II.

Difference of Latitude and Departure for 24 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	55.7	24.8	121	110.5	49.2	181	165.4	73.6	241	220.2	98.0
2	01.8	00.8	62	56.6	25.2	122	111.5	49.6	182	166.3	74.0	242	221.1	98.4
3	02.7	01.2	63	57.6	25.6	123	112.4	50.0	183	167.2	74.4	243	222.0	98.8
4	03.7	01.6	64	58.5	26.0	124	113.3	50.4	184	168.1	74.8	244	222.9	99.2
5	04.6	02.0	65	59.4	26.4	125	114.2	50.8	185	169.0	75.2	245	223.8	99.7
6	05.5	02.4	66	60.3	26.8	126	115.1	51.2	186	169.9	75.7	246	224.7	100.1
7	06.4	02.8	67	61.2	27.3	127	116.0	51.7	187	170.8	76.1	247	225.6	100.5
8	07.3	03.3	68	62.1	27.7	128	116.9	52.1	188	171.7	76.5	248	226.6	100.9
9	08.2	03.7	69	63.0	28.1	129	117.8	52.5	189	172.7	76.9	249	227.5	101.3
10	09.1	04.1	70	63.9	28.5	130	118.8	52.9	190	173.6	77.3	250	228.4	101.7
11	10.0	04.5	71	64.9	28.9	131	119.7	53.3	191	174.5	77.7	251	229.3	102.1
12	11.0	04.9	72	65.8	29.3	132	120.6	53.7	192	175.4	78.1	252	230.2	102.5
13	11.9	05.3	73	66.7	29.7	133	121.5	54.1	193	176.3	78.5	253	231.1	102.9
14	12.8	05.7	74	67.6	30.1	134	122.4	54.5	194	177.2	78.9	254	232.0	103.3
15	13.7	06.1	75	68.5	30.5	135	123.3	54.9	195	178.1	79.3	255	233.0	103.7
16	14.6	06.5	76	69.4	30.9	136	124.2	55.3	196	179.1	79.7	256	233.9	104.1
17	15.5	06.9	77	70.3	31.3	137	125.2	55.7	197	180.0	80.1	257	234.8	104.5
18	16.4	07.3	78	71.3	31.7	138	126.1	56.1	198	180.9	80.5	258	235.7	104.9
19	17.4	07.7	79	72.2	32.1	139	127.0	56.5	199	181.8	80.9	259	236.6	105.3
20	18.3	08.1	80	73.1	32.5	140	127.9	56.9	200	182.7	81.3	260	237.5	105.8
21	19.2	08.5	81	74.0	32.9	141	128.8	57.3	201	183.6	81.8	261	238.4	106.2
22	20.1	08.9	82	74.9	33.4	142	129.7	57.8	202	184.5	82.2	262	239.3	106.6
23	21.0	09.4	83	75.8	33.8	143	130.6	58.2	203	185.4	82.6	263	240.3	107.0
24	21.9	09.8	84	76.7	34.2	144	131.6	58.6	204	186.4	83.0	264	241.2	107.4
25	22.8	10.2	85	77.7	34.6	145	132.5	59.0	205	187.3	83.4	265	242.1	107.8
26	23.8	10.6	86	78.6	35.0	146	133.4	59.4	206	188.2	83.8	266	243.0	108.2
27	24.7	11.0	87	79.5	35.4	147	134.3	59.8	207	189.1	84.2	267	243.9	108.6
28	25.6	11.4	88	80.4	35.8	148	135.2	60.2	208	190.0	84.6	268	244.8	109.0
29	26.5	11.8	89	81.3	36.2	149	136.1	60.6	209	190.9	85.0	269	245.7	109.4
30	27.4	12.2	90	82.2	36.6	150	137.0	61.0	210	191.8	85.4	270	246.7	109.8
31	28.3	12.6	91	83.1	37.0	151	137.9	61.4	211	192.8	85.8	271	247.6	110.2
32	29.2	13.0	92	84.0	37.4	152	138.9	61.8	212	193.7	86.2	272	248.5	110.6
33	30.1	13.4	93	85.0	37.8	153	139.8	62.2	213	194.6	86.6	273	249.4	111.0
34	31.1	13.8	94	85.9	38.2	154	140.7	62.6	214	195.5	87.0	274	250.3	111.4
35	32.0	14.2	95	86.8	38.6	155	141.6	63.0	215	196.4	87.4	275	251.2	111.9
36	32.9	14.6	96	87.7	39.0	156	142.5	63.5	216	197.3	87.9	276	252.1	112.3
37	33.8	15.0	97	88.6	39.5	157	143.4	63.9	217	198.2	88.3	277	253.1	112.7
38	34.7	15.5	98	89.5	39.9	158	144.3	64.3	218	199.2	88.7	278	254.0	113.1
39	35.6	15.9	99	90.4	40.3	159	145.3	64.7	219	200.1	89.1	279	254.9	113.5
40	36.5	16.3	100	91.4	40.7	160	146.2	65.1	220	201.0	89.5	280	255.8	113.9
41	37.5	16.7	101	92.3	41.1	161	147.1	65.5	221	201.9	89.9	281	256.7	114.3
42	38.4	17.1	102	93.2	41.5	162	148.0	65.9	222	202.8	90.3	282	257.6	114.7
43	39.3	17.5	103	94.1	41.9	163	148.9	66.3	223	203.7	90.7	283	258.5	115.1
44	40.2	17.9	104	95.0	42.3	164	149.8	66.7	224	204.6	91.1	284	259.4	115.5
45	41.1	18.3	105	95.9	42.7	165	150.7	67.1	225	205.5	91.5	285	260.4	115.9
46	42.0	18.7	106	96.8	43.1	166	151.6	67.5	226	206.5	91.9	286	261.3	116.3
47	42.9	19.1	107	97.7	43.5	167	152.6	67.9	227	207.4	92.3	287	262.2	116.7
48	43.9	19.5	108	98.7	43.9	168	153.5	68.3	228	208.3	92.7	288	263.1	117.1
49	44.8	19.9	109	99.6	44.3	169	154.4	68.7	229	209.2	93.1	289	264.0	117.5
50	45.7	20.3	110	100.5	44.7	170	155.3	69.1	230	210.1	93.5	290	264.9	118.0
51	46.6	20.7	111	101.4	45.1	171	156.2	69.6	231	211.0	94.0	291	265.8	118.4
52	47.5	21.2	112	102.3	45.6	172	157.1	70.0	232	211.9	94.4	292	266.8	118.8
53	48.4	21.6	113	103.2	46.0	173	158.0	70.4	233	212.9	94.8	293	267.7	119.2
54	49.3	22.0	114	104.1	46.4	174	159.0	70.8	234	213.8	95.2	294	268.6	119.6
55	50.2	22.4	115	105.1	46.8	175	159.9	71.2	235	214.7	95.6	295	269.5	120.0
56	51.2	22.8	116	106.0	47.2	176	160.8	71.6	236	215.6	96.0	296	270.4	120.4
57	52.1	23.2	117	106.9	47.6	177	161.7	72.0	237	216.5	96.4	297	271.3	120.8
58	53.0	23.6	118	107.8	48.0	178	162.6	72.4	238	217.4	96.8	298	272.2	121.2
59	53.9	24.0	119	108.7	48.4	179	163.5	72.8	239	218.3	97.2	299	273.2	121.6
60	54.8	24.4	120	109.6	48.8	180	164.4	73.2	240	219.3	97.6	300	274.1	122.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 66 Degrees.

TABLE II.

Difference of Latitude and Departure for 25 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	55.3	25.8	121	109.7	51.1	181	164.0	76.5	241	218.4	101.9
2	01.8	00.8	62	56.2	26.2	122	110.6	51.6	182	164.9	76.9	242	219.3	102.3
3	02.7	01.3	63	57.1	26.6	123	111.5	52.0	183	165.9	77.3	243	220.2	102.7
4	03.6	01.7	64	58.0	27.0	124	112.4	52.4	184	166.8	77.8	244	221.1	103.1
5	04.5	02.1	65	58.9	27.5	125	113.3	52.8	185	167.7	78.2	245	222.0	103.5
6	05.4	02.5	66	59.8	27.9	126	114.2	53.2	186	168.6	78.6	246	223.0	104.0
7	06.3	03.0	67	60.7	28.3	127	115.1	53.7	187	169.5	79.0	247	223.9	104.4
8	07.3	03.4	68	61.6	28.7	128	116.0	54.1	188	170.4	79.5	248	224.8	104.8
9	08.2	03.8	69	62.5	29.2	129	116.9	54.5	189	171.3	79.9	249	225.7	105.2
10	09.1	04.2	70	63.4	29.6	130	117.8	54.9	190	172.2	80.3	250	226.6	105.7
11	10.0	04.6	71	64.3	30.0	131	118.7	55.4	191	173.1	80.7	251	227.5	106.1
12	10.9	05.1	72	65.3	30.4	132	119.6	55.8	192	174.0	81.1	252	228.4	106.5
13	11.8	05.5	73	66.2	30.9	133	120.5	56.2	193	174.9	81.6	253	229.3	106.9
14	12.7	05.9	74	67.1	31.3	134	121.4	56.6	194	175.8	82.0	254	230.2	107.3
15	13.6	06.3	75	68.0	31.7	135	122.4	57.1	195	176.7	82.4	255	231.1	107.8
16	14.5	06.8	76	68.9	32.1	136	123.3	57.5	196	177.6	82.8	256	232.0	108.2
17	15.4	07.2	77	69.8	32.5	137	124.2	57.9	197	178.5	83.3	257	232.9	108.6
18	16.3	07.6	78	70.7	33.0	138	125.1	58.3	198	179.4	83.7	258	233.8	109.0
19	17.2	08.0	79	71.6	33.4	139	126.0	58.7	199	180.4	84.1	259	234.7	109.5
20	18.1	08.5	80	72.5	33.8	140	126.9	59.2	200	181.3	84.5	260	235.6	109.9
21	19.0	08.9	81	73.4	34.2	141	127.8	59.6	201	182.2	84.9	261	236.5	110.3
22	19.9	09.3	82	74.3	34.7	142	128.7	60.0	202	183.1	85.4	262	237.5	110.7
23	20.8	09.7	83	75.2	35.1	143	129.6	60.4	203	184.0	85.8	263	238.4	111.1
24	21.8	10.1	84	76.1	35.5	144	130.5	60.9	204	184.9	86.2	264	239.3	111.6
25	22.7	10.6	85	77.0	35.9	145	131.4	61.3	205	185.8	86.6	265	240.2	112.0
26	23.6	11.0	86	77.9	36.3	146	132.3	61.7	206	186.7	87.1	266	241.1	112.4
27	24.5	11.4	87	78.8	36.8	147	133.2	62.1	207	187.6	87.5	267	242.0	112.8
28	25.4	11.8	88	79.8	37.2	148	134.1	62.5	208	188.5	87.9	268	242.9	113.3
29	26.3	12.3	89	80.7	37.6	149	135.0	63.0	209	189.4	88.3	269	243.8	113.7
30	27.2	12.7	90	81.6	38.0	150	135.9	63.4	210	190.3	88.7	270	244.7	114.1
31	28.1	13.1	91	82.5	38.5	151	136.9	63.8	211	191.2	89.2	271	245.6	114.5
32	29.0	13.5	92	83.4	38.9	152	137.8	64.2	212	192.1	89.6	272	246.5	115.0
33	29.9	13.9	93	84.3	39.3	153	138.7	64.7	213	193.0	90.0	273	247.4	115.4
34	30.8	14.4	94	85.2	39.7	154	139.6	65.1	214	193.9	90.4	274	248.3	115.8
35	31.7	14.8	95	86.1	40.1	155	140.5	65.5	215	194.9	90.9	275	249.2	116.2
36	32.6	15.2	96	87.0	40.6	156	141.4	65.9	216	195.8	91.3	276	250.1	116.6
37	33.5	15.6	97	87.9	41.0	157	142.3	66.4	217	196.7	91.7	277	251.0	117.1
38	34.4	16.1	98	88.8	41.4	158	143.2	66.8	218	197.6	92.1	278	252.0	117.5
39	35.3	16.5	99	89.7	41.8	159	144.1	67.2	219	198.5	92.6	279	252.9	117.9
40	36.3	16.9	100	90.6	42.3	160	145.0	67.6	220	199.4	93.0	280	253.8	118.3
41	37.2	17.3	101	91.5	42.7	161	145.9	68.0	221	200.3	93.4	281	254.7	118.8
42	38.1	17.7	102	92.4	43.1	162	146.8	68.5	222	201.2	93.8	282	255.6	119.2
43	39.0	18.2	103	93.3	43.5	163	147.7	68.9	223	202.1	94.2	283	256.5	119.6
44	39.0	18.6	104	94.3	44.0	164	148.6	69.3	224	203.0	94.7	284	257.4	120.0
45	40.8	19.0	105	95.2	44.4	165	149.5	69.7	225	203.9	95.1	285	258.3	120.4
46	41.7	19.4	106	96.1	44.8	166	150.4	70.2	226	204.8	95.5	286	259.2	120.9
47	42.6	19.9	107	97.0	45.2	167	151.4	70.6	227	205.7	95.9	287	260.1	121.3
48	43.5	20.3	108	97.9	45.6	168	152.3	71.0	228	206.6	96.4	288	261.0	121.7
49	44.4	20.7	109	98.8	46.1	169	153.2	71.4	229	207.5	96.8	289	261.9	122.1
50	45.3	21.1	110	99.7	46.5	170	154.1	71.8	230	208.5	97.2	290	262.8	122.6
51	46.2	21.6	111	100.6	46.9	171	155 0	72.3	231	209.4	97.6	291	263.7	123.0
52	47.1	22.0	112	101.5	47.3	172	155.9	72.7	232	210.3	98.0	292	264.6	123.4
53	48.0	22.4	113	102.4	47.8	173	156.8	73.1	233	211.2	98.5	293	265.5	123.8
54	48.9	22.8	114	103.3	48.2	174	157.7	73.5	234	212.1	98.9	294	266.5	124.2
55	49.8	23.2	115	104.2	48.6	175	158.6	74.0	235	213.0	99.3	295	267.4	124.7
56	50.8	23.7	116	105.1	49.0	176	159.5	74.4	236	213.9	99.7	296	268.3	125.1
57	51.7	24.1	117	106.0	49.4	177	160.4	74.8	237	214.8	100.2	297	269.2	125.5
58	52.6	24.5	118	106.9	49.9	178	161.3	75.2	238	215.7	100.6	298	270.1	125.9
59	53.5	24.9	119	107.9	50.3	179	162.2	75.6	239	216.6	101.0	299	271.0	126.4
60	54.4	25.4	120	108.8	50.7	180	163.1	76.1	240	217.5	101.4	300	271.9	126.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 65 Degrees.

TABLE II.

Difference of Latitude and Departure for 26 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	54.8	26.7	121	108.8	53.0	181	162.7	79.3	241	216.6	105.6
2	01.8	00.9	62	55.7	27.2	122	109.7	53.5	182	163.6	79.8	242	217.5	106.1
3	02.7	01.3	63	56.6	27.6	123	110.6	53.9	183	164.5	80.2	243	218.4	106.5
4	03.6	01 8	64	57.5	28.1	124	111.5	54.4	184	165.4	80.7	244	219.3	107.0
5	04.5	02.2	65	58.4	28.5	125	112.3	54.8	185	166.3	81.1	245	220.2	107.4
6	05.4	02.6	66	59.3	28.9	126	113.2	55.2	186	167.2	81.5	246	221.1	107.8
7	06.3	03.1	67	60.2	29.4	127	114.1	55.7	187	168.1	82.0	247	222.0	108.3
8	07.2	03.5	68	61.1	29.8	128	115.0	56.1	188	169.0	82.4	248	222.9	108.7
9	08.1	03.9	69	62.0	30.2	129	115.9	56.5	189	169.9	82.9	249	223.8	109.2
10	09.0	04.4	70	62.9	30.7	130	116.8	57.0	190	170.8	83.3	250	224.7	109.6
11	09.9	04.8	71	63.8	31.1	131	117.7	57.4	191	171.7	83.7	251	225.6	110.0
12	10.8	05.3	72	64.7	31.6	132	118.6	57.9	192	172.6	84.2	252	226.5	110.5
13	11.7	05.7	73	65.6	32.0	133	119.5	58.3	193	173.5	84.6	253	227.4	110.9
14	12.6	06.1	74	66.5	32.4	134	120.4	58.7	194	174.4	85.0	254	228.3	111.3
15	13.5	06.6	75	67.4	32.9	135	121.3	59.2	195	175.3	85.5	255	229.2	111.8
16	14.4	07.0	76	68.3	33.3	136	122.2	59.6	196	176.2	85.9	256	230.1	112.2
17	15.3	07.5	77	69.2	33.8	137	123.1	60.1	197	177.1	86.4	257	231.0	112.7
18	16.2	07.9	78	70.1	34.2	138	124.0	60.5	198	178.0	86.8	258	231.9	113.1
19	17.1	08.3	79	71.0	34.6	139	124.9	60.9	199	178.9	87.2	259	232.8	113.5
20	18.0	08.8	80	71.9	35.1	140	125.8	61 4	200	179.8	87.7	260	233.7	114.0
21	18.9	09.2	81	72.8	35.5	141	126.7	61.8	201	180.7	88.1	261	234.6	114.4
22	19.8	09.6	82	73.7	35.9	142	127.6	62.2	202	181.6	88.6	262	235.5	114.9
23	20.7	10.1	83	74.6	36.4	143	128.5	62.7	203	182.5	89.0	263	236.4	115.3
24	21.6	10.5	84	75.5	36.8	144	129.4	63.1	204	183.4	89.4	264	237.3	115.7
25	22.5	11.0	85	76.4	37.3	145	130.3	63.6	205	184.3	89.9	265	238.2	116.2
26	23.4	11.4	86	77.3	37.7	146	131.2	64.0	206	185.2	90.3	266	239.1	116.6
27	24.3	11.8	87	78.2	38.1	147	132.1	64.4	207	186.1	90.7	267	240.0	117.0
28	25.2	12.3	88	79.1	38.6	148	133.0	64.9	208	186.9	91.2	268	240.9	117.5
29	26.1	12.7	89	80.0	39.0	149	133.9	65.3	209	187.8	91.6	269	241.8	117.9
30	27.0	13.2	90	80.9	39.5	150	134.8	65.8	210	188.7	92.1	270	242.7	118.4
31	27.9	13.6	91	81.8	39.9	151	135.7	66.2	211	189.6	92.5	271	243.6	118.8
32	28.8	14.0	92	82.7	40.3	152	136.6	66.6	212	190.5	92.9	272	244.5	119.2
33	29.7	14.5	93	83.6	40.8	153	137.5	67.1	213	191.4	93.4	273	245.4	119.7
34	30.6	14.9	94	84.5	41.2	154	138.4	67.5	214	192.3	93.8	274	246.3	120.1
35	31.5	15.3	95	85.4	41.6	155	139.3	67.9	215	193.2	94.2	275	247.2	120.6
36	32.4	15.8	96	86.3	42.1	156	140.2	68.4	216	194.1	94.7	276	248.1	121.0
37	33.3	16.2	97	87.2	42.5	157	141.1	68.8	217	195.0	95.1	277	249.0	121.4
38	34.2	16.7	98	88.1	43.0	158	142.0	69.3	218	195.9	95.6	278	249.9	121.9
39	35.1	17.1	99	89.0	43.4	159	142.9	69.7	219	196.8	96.0	279	250.8	122.3
40	36 0	17.5	100	89.9	43.8	160	143.8	70.1	220	197.7	96.4	280	251.7	122.7
41	36.9	18.0	101	90.8	44.3	161	144.7	70.6	221	198.6	96.9	281	252.6	123.2
42	37.7	18.4	102	91.7	44.7	162	145.6	71.0	222	199.5	97.3	282	253.5	123 6
43	38.6	18.8	103	92.6	45.2	163	146.5	71.5	223	200.4	97.8	283	254.4	124.1
44	39.5	19.3	104	93.5	45.6	164	147.4	71.9	224	201.3	98.2	284	255.3	124.5
45	40.4	19.7	105	94.4	46.0	165	148.3	72.3	225	202.2	98.6	285	256.2	124.9
46	41.3	20.2	106	95.3	46.5	166	149.2	72.8	226	203.1	99.1	286	257.1	125.4
47	42.2	20.6	107	96.2	46.9	167	150.1	73.2	227	204.0	99.5	287	258.0	125.8
48	43.1	21.0	108	97.1	47.3	168	151.0	73.6	228	204.9	99.9	288	258.9	126.3
49	44.0	21.5	109	98.0	47.8	169	151.9	74.1	229	205.8	100.4	289	259.8	126.7
50	44.9	21.9	110	98.9	48.2	170	152.8	74.5	230	206.7	100.8	290	260.7	127.1
51	45.8	22.4	111	99.8	48.7	171	153.7	75.0	231	207.6	101.3	291	261.5	127.6
52	46.7	22.8	112	100.7	49.1	172	154.6	75.4	232	208.5	101.7	292	262.4	128.0
53	47.6	23.2	113	101.6	49.5	173	155.5	75.8	233	209.4	102.1	293	263.3	128.4
54	48.5	23.7	114	102.5	50.0	174	156.4	76.3	234	210.3	162.6	294	264.2	128.9
55	49.4	24.1	115	103.4	50.4	175	157.3	76.7	235	211.2	103.0	295	265.1	129.3
56	50.3	24.5	116	104.3	50.9	176	158.2	77.2	236	212.1	103.5	296	266.0	129.8
57	51.2	25.0	117	105.2	51.3	177	159.1	77.6	237	213.0	103.9	297	266.9	130.2
58	52.1	25.4	118	106.1	51.7	178	160.0	78.0	238	213.9	104.3	298	267.8	130.6
59	53.0	25.9	119	107.0	52.2	179	160.9	78.5	239	214.8	104.8	299	268.7	131.1
60	53.9	26.3	120	107.9	52.6	180	161.8	78.9	240	215.7	105.2	300	269.6	131.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 64 Degrees.

Difference of Latitude and Departure for 27 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	54.4	27.7	121	107.8	54.9	181	161.3	82.2	241	214.7	109.4
2	01.8	00.9	62	55.2	28.1	122	108.7	55.4	182	162.2	82.6	242	215.6	109.9
3	02.7	01.4	63	56.1	28.6	123	109.6	55.8	183	163.1	83.1	243	216.5	110 3
4	03.6	01.8	64	57.0	29.1	124	110.5	56.3	184	163.9	83.5	244	217.4	110.8
5	04.5	02.3	65	57.9	29.5	125	111.4	56.7	185	164.8	84.0	245	218.3	111.2
6	05.3	02.7	66	58.8	30.0	126	112.3	57.2	186	165.7	84.4	246	219.2	111.7
7	06.2	03.2	67	59.7	30.4	127	113.2	57.7	187	166.6	84.9	247	220.1	112.1
8	07.1	03.6	68	60.6	30.9	128	114.0	58.1	188	167.5	85.4	248	221.0	112.6
9	08.0	04.1	69	61.5	31.3	129	114.9	58.6	189	168.4	85.8	249	221.9	113.0
10	08.9	04.5	70	62.4	31.8	130	115.8	59.0	190	169.3	86.3	250	222.8	113.5
11	09.8	05.0	71	63.3	32.2	131	116.7	59.5	191	170.2	86.7	251	223.6	114.0
12	10.7	05.4	72	64.2	32.7	132	117.6	59.9	192	171.1	87.2	252	224.5	114.4
13	11.6	05.9	73	65.0	33.1	133	118.5	60.4	193	172.0	87.6	253	225.4	114.9
14	12.5	06.4	74	65.9	33.6	134	119.4	60.8	194	172.9	88.1	254	226.3	115.3
15	13.4	06.8	75	66.8	34.0	135	120.3	61.3	195	173.7	88.5	255	227.2	115.8
16	14.3	07.3	76	67.7	34.5	136	121.2	61.7	196	174.6	89.0	256	228.1	116.2
17	15.1	07.7	77	68.6	35.0	137	122.1	62.2	197	175.5	89.4	257	229.0	116.7
18	16.0	08.2	78	69.5	35.4	138	123.0	62.7	198	176.4	89.9	258	229.9	117.1
19	16.9	08.6	79	70.4	35.9	139	123.8	63.1	199	177.3	90.3	259	230.8	117.6
20	17.8	09.1	80	71.3	36.3	140	124.7	63.6	200	178.2	90.8	260	231.7	118.0
21	18.7	09.5	81	72.2	36.8	141	125.6	64.0	201	179.1	91.3	261	232.6	118.5
22	19.6	10.0	82	73.1	37.2	142	126.5	64.5	202	180.0	91.7	262	233.4	118.9
23	20.5	10.4	83	74.0	37.7	143	127.4	64.9	203	180.9	92.2	263	234.3	119.4
24	21.4	10.9	84	74.8	38.1	144	128.3	65.4	204	181.8	92.6	264	235.2	119.9
25	22.3	11.3	85	75.7	38.6	145	129.2	65.8	205	182.7	93.1	265	236.1	120.3
26	23.2	11.8	86	76.6	39.0	146	130.1	66.3	206	183.5	93.5	266	237.0	120.8
27	24.1	12.3	87	77.5	39.5	147	131.0	66.7	207	184.4	94.0	267	237.9	121.2
28	24.9	12.7	88	78.4	40.0	148	131.9	67.2	208	185.3	94.4	268	238.8	121.7
29	25 8	13.2	89	79.3	40.4	149	132.8	67.6	209	186.2	94.9	269	239.7	122.1
30	26.7	13.6	90	80.2	40.9	150	133.7	68.1	210	187.1	95.3	270	240.6	122.6
31	27.6	14.1	91	81.1	41.3	151	134.5	68.6	211	188.0	95.8	271	241.5	123.0
32	28.5	14.5	92	82.0	41.8	152	135.4	69.0	212	188.9	96.2	272	242.4	123.5
33	29.4	15.0	93	82.9	42.2	153	136.3	69.5	213	189.8	96.7	273	243.2	123.9
34	30.3	15.4	94	83.8	42.7	154	137.2	69.9	214	190.7	97.2	274	244.1	124.4
35	31.2	15.9	95	84.6	43.1	155	138.1	70.4	215	191.6	97.6	275	245.0	124.8
36	32.1	16.3	96	85.5	43.6	156	139.0	70.8	216	192.5	98.1	276	245.9	125.3
37	33.0	16.8	97	86.4	44.0	157	139.9	71.3	217	193.3	98.5	277	246.8	125.8
38	33.9	17.3	98	87.3	44.5	158	140.8	71.7	218	194.2	99.0	278	247.7	126.2
39	34.7	17.7	99	88.2	44.9	159	141.7	72.2	219	195.1	99.4	279	248.6	126.7
40	35.6	18.2	100	89.1	45.4	160	142.6	72.6	220	196.0	99.9	280	249.5	127.1
41	36.5	18.6	101	90.0	45.9	161	143.5	73.1	221	196.9	100.3	281	250.4	127.6
42	37.4	19.1	102	90.9	46.3	162	144.3	73.5	222	197.8	100.8	282	251.3	128.0
43	38.3	19.5	103	91.8	46.8	163	145.2	74.0	223	198.7	101.2	283	252.2	128.5
44	39.2	20.0	104	92.7	47.2	164	146.1	74.5	224	199.6	101.7	284	253.0	128.9
45	40.1	20.4	105	93.6	47.7	165	147.0	74.9	225	200.5	102.1	285	253.9	129.4
46	41.0	20.9	106	94.4	48.1	166	147.9	75.4	226	201.4	102.6	286	254.8	129.8
47	41.9	21.3	107	95.3	48.6	167	148.8	75.8	227	202.3	103.1	287	255.7	130 3
48	42.8	21.8	108	96.2	49.0	168	149.7	76.3	228	203.1	103.5	288	256.6	130.7
49	43.7	22.2	109	97.1	49.5	169	150.6	76.7	229	204.0	104.0	289	257.5	131.2
50	44.6	22.7	110	98.0	49.9	170	151.5	77.2	230	204.9	104.4	290	258.4	131.7
51	45.4	23.2	111	98.9	50.4	171	152.4	77.6	231	205.8	104.9	291	259.3	132.1
52	46.3	23.6	112	99.8	50.8	172	153.3	78.1	232	206.7	105.3	292	260.2	132.6
53	47.2	24.1	113	100.7	51.3	173	154.1	78.5	233	207.6	105.8	293	261.1	133.0
54	48.1	24.5	114	101.6	51.8	174	155.0	79.0	234	208.5	106.2	294	262.0	133.5
55	49.0	25.0	115	102.5	52.2	175	155.9	79.4	235	209.4	106.7	295	262.8	133.9
56	49.9	25.4	116	103.4	52.7	176	156.8	79.9	236	210.3	107.1	296	263.7	134.4
57	50.8	25.9	117	104.2	53.1	177	157.7	80.4	237	211.2	107.6	297	264.6	134.8
58	51.7	26.3	118	105.1	53.6	178	158.6	80.8	238	212.1	108.0	298	265.5	135.3
59	52.6	26.8	119	106.0	54.0	179	159.5	81.3	239	213.0	108.5	299	266.4	135.7
60	53.5	27.2	120	106.9	54.5	180	160.4	81.7	240	213.8	109.0	300	267.3	136.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 63 Degrees.

TABLE II.

Difference of Latitude and Departure for 28 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	53.9	28.6	121	106.8	56.8	181	159.8	85.0	241	212.8	113.1
2	01.8	00.9	62	54.7	29.1	122	107.7	57.3	182	160.7	85.4	242	213.7	113.6
3	02.6	01.4	63	55.6	29.6	123	108.6	57.7	183	161.6	85.9	243	214.6	114.1
4	03.5	01.9	64	56.5	30.0	124	109.5	58.2	184	162.5	86.4	244	215.4	114.6
5	04.4	02.3	65	57.4	30.5	125	110.4	58.7	185	163.3	86.9	245	216.3	115.0
6	05.3	02.8	66	58.3	31.0	126	111.3	59.2	186	164.2	87.3	246	217.2	115.5
7	06.2	03.3	67	59.2	31.5	127	112.1	59.6	187	165.1	87.8	247	218.1	116.0
8	07.1	03.8	68	60.0	31.9	128	113.0	60.1	188	166.0	88.3	248	219.0	116.4
9	07.9	04.2	69	60.9	32.4	129	113.9	60.6	189	166.9	88.7	249	219.9	116.9
10	08.8	04.7	70	61.8	32.9	130	114.8	61.0	190	167.8	89.2	250	220.7	117.4
11	09.7	05.2	71	62.7	33.3	131	115.7	61.5	191	168.6	89.7	251	221.6	117.8
12	10.6	05.6	72	63.6	33.8	132	116.5	62.0	192	169.5	90.1	252	222.5	118.3
13	11.5	06.1	73	64.5	34.3	133	117.4	62.4	193	170.4	90.6	253	223.4	118.8
14	12.4	06.6	74	65.3	34.7	134	118.3	62.9	194	171.3	91.1	254	224.3	119.2
15	13.2	07.0	75	66.2	35.2	135	119.2	63.4	195	172.2	91.5	255	225.2	119.7
16	14.1	07.5	76	67.1	35.7	136	120.1	63.8	196	173.1	92.0	256	226.0	120.2
17	15.0	08.0	77	68.0	36.1	137	121.0	64.3	197	173.9	92.5	257	226.9	120.7
18	15.9	08.5	78	68.9	36.6	138	121.8	64.8	198	174.8	93.0	258	227.8	121.1
19	16.8	08.9	79	69.8	37.1	139	122.7	65.3	199	175.7	93.4	259	228.7	121.6
20	17.7	09.4	80	70.6	37.6	140	123.6	65.7	200	176.6	93.9	260	229.6	122.1
21	18.5	09.9	81	71.5	38.0	141	124.5	66.2	201	177.5	94.4	261	230.4	122.5
22	19.4	10.3	82	72.4	38.5	142	125.4	66.7	202	178.4	94.8	262	231.3	123.0
23	20.3	10.8	83	73.3	39.0	143	126.3	67.1	203	179.2	95.3	263	232.2	123.5
24	21.2	11.3	84	74.2	39.4	144	127.1	67.6	204	180.1	95.8	264	233.1	123.9
25	22.1	11.7	85	75.1	39.9	145	128.0	68.1	205	181.0	96.2	265	234.0	124.4
26	23.0	12.2	86	75.9	40.4	146	128.9	68.5	206	181.9	96.7	266	234.9	124.9
27	23.8	12.7	87	76.8	40.8	147	129.8	69.0	207	182.8	97.2	267	235.7	125.3
28	24.7	13.1	88	77.7	41.3	148	130.7	69.5	208	183.7	97.7	268	236.6	125.8
29	25.6	13.6	89	78.6	41.8	149	131.6	70.0	209	184.5	98.1	269	237.5	126.3
30	26.5	14.1	90	79.5	42.3	150	132.4	70.4	210	185.4	98.6	270	238.4	126.8
31	27.4	14.6	91	80.3	42.7	151	133.3	70.9	211	186.3	99.1	271	239.3	127.2
32	28.3	15.0	92	81.2	43.2	152	134.2	71.4	212	187.2	99.5	272	240.2	127.7
33	29.1	15.5	93	82.1	43.7	153	135.1	71.8	213	188.1	100.0	273	241.0	128.2
34	30.0	16.0	94	83.0	44.1	154	136.0	72.3	214	189.0	100.5	274	241.9	128.6
35	30.9	16.4	95	83.9	44.6	155	136.9	72.8	215	189.8	100.9	275	242.8	129.1
36	31.8	16.9	96	84.8	45.1	156	137.7	73.2	216	190.7	101.4	276	243.7	129.6
37	32.7	17.4	97	85.6	45.5	157	138.6	73.7	217	191.6	101.9	277	244.6	130.0
38	33.6	17.8	98	86.5	46.0	158	139.5	74.2	218	192.5	102.3	278	245.5	130.5
39	34.4	18.3	99	87.4	46.5	159	140.4	74.6	219	193.4	102.8	279	246.3	131.0
40	35.3	18.8	100	88.3	46.9	160	141.3	75.1	220	194.2	103.3	280	247.2	131.5
41	36.2	19.2	101	89.2	47.4	161	142.2	75.6	221	195.1	103.8	281	248.1	131.9
42	37.1	19.7	102	00.1	47.9	162	143.0	76.1	222	196.0	104.2	282	249.0	132.4
43	38.0	20.2	103	90.9	48.4	163	143.9	76.5	223	196.9	104.7	283	249.9	132.9
44	38.8	20.7	104	91.8	48.8	164	144.8	77.0	224	197.8	105.2	284	250.8	133.3
45	39.7	21.1	105	92.7	49.3	165	145.7	77.5	225	198.7	105.6	285	251.6	133.8
46	40.6	21.6	106	93.6	49.8	166	146.6	77.9	226	199.5	106.1	286	252.5	134.3
47	41.5	22.1	107	94.5	50.2	167	147.5	78.4	227	200.4	106.6	287	253.4	134.7
48	42.4	22.5	108	95.4	50.7	168	148.3	78.9	228	201.3	107.0	288	254.3	135.2
49	43.3	23.0	109	96.2	51.2	169	149.2	79.3	229	202.2	107.5	289	255.2	135.7
50	44.1	23.5	110	97.1	51.6	170	150.1	79.8	230	203.1	108.0	290	256.1	136.1
51	45.0	23.9	111	98.0	52.1	171	151.0	80.3	231	204.0	108.4	291	256.9	136.6
52	45.9	24.4	112	98.9	52.6	172	151.9	80.7	232	204.8	108.9	292	257.8	137.1
53	46.8	24.9	113	99.8	53.1	173	152.7	81.2	233	205.7	109.4	293	258.7	137.6
54	47.7	25.4	114	100.7	53.5	174	153.6	81.7	234	206.6	109.9	294	259.6	138.0
55	48.6	25.8	115	101.5	54.0	175	154.5	82.2	235	207.5	110.3	295	260.5	138.5
56	49.4	26.3	116	102.4	54.5	176	155.4	82.6	236	208.4	110.8	296	261.3	139.0
57	50.3	26.8	117	103.3	54.9	177	156.3	83.1	237	209.3	111.3	297	262.2	139.4
58	51.2	27.2	118	104.2	55.4	178	157.2	83.6	238	210.1	111.7	298	263.1	139.9
59	52.1	27.7	119	105.1	55.9	179	158.0	84.0	239	211.0	112.2	299	264.0	140.4
60	53.0	28.2	120	106.0	56.3	180	158.9	84.5	240	211.9	112.7	300	264.9	140.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 62 Degrees.

TABLE II.

Difference of Latitude and Departure for 29 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	53.4	29.6	121	105.8	58.7	181	158.3	87.8	241	210.8	116.8
2	01.7	01.0	62	54.2	30.1	122	106.7	59.1	182	159.2	88.2	242	211.7	117.3
3	02.6	01.5	63	55.1	30.5	123	107.6	59.6	183	160.1	88.7	243	212.5	117.8
4	03.5	01.9	64	56.0	31.0	124	108.5	60.1	184	160.9	89.2	244	213.4	118.3
5	04.4	02.4	65	56.9	31.5	125	109.3	60.6	185	161.8	89.7	245	214.3	118.8
6	05.2	02.9	66	57.7	32.0	126	110.2	61.1	186	162.7	90.2	246	215.2	119.3
7	06.1	03.4	67	58.6	32.5	127	111.1	61.6	187	163.6	90.7	247	216.0	119.7
8	07.0	03.9	68	59.5	33.0	128	112.0	62.1	188	164.4	91.1	248	216.9	120.2
9	07.9	04.4	69	60.3	33.5	129	112.8	62.5	189	165.3	91.6	249	217.8	120.7
10	08.7	04.8	70	61.2	33.9	130	113.7	63.0	190	166.2	92.1	250	218.7	121.2
11	09.6	05.3	71	62.1	34.4	131	114.6	63.5	191	167.1	92.6	251	219.5	121.7
12	10.5	05.8	72	63.0	34.9	132	115.4	64.0	192	167.9	93.1	252	220.4	122.2
13	11.4	06.3	73	63.8	35.4	133	116.3	64.5	193	168.8	93.6	253	221.3	122.7
14	12.2	06.8	74	64.7	35.9	134	117.2	65.0	194	169.7	94.1	254	222.2	123.1
15	13.1	07.3	75	65.6	36.4	135	118.1	65.4	195	170.6	94.5	255	223.0	123.6
16	14.0	07.8	76	66.5	36.8	136	118.9	65.9	196	171.4	95.0	256	223.9	124.1
17	14.9	08.2	77	67.3	37.3	137	119.8	66.4	197	172.3	95.5	257	224.8	124.6
18	15.7	08.7	78	68.2	37.8	138	120.7	66.9	198	173.2	96.0	258	225.7	125.1
19	16.6	09.2	79	69.1	38.3	139	121.6	67.4	199	174.0	96.5	259	226.5	125.6
20	17.5	09.7	80	70.0	38.8	140	122.4	67.9	200	174.9	97.0	260	227.4	126.1
21	18.4	10.2	81	70.8	39.3	141	123.3	68.4	201	175.8	97.4	261	228.3	126.5
22	19.2	10.7	82	71.7	39.8	142	124.2	68.8	202	176.7	97.9	262	229.2	127.0
23	20.1	11.2	83	72.6	40.2	143	125.1	69.3	203	177.5	98.4	263	230.0	127.5
24	21.0	11.6	84	73.5	40.7	144	125.9	69.8	204	178.4	98.9	264	230.9	128.0
25	21.9	12.1	85	74.3	41.2	145	126.8	70.3	205	179.3	99.4	265	231.8	128.5
26	22.7	12.6	86	75.2	41.7	146	127.7	70.8	206	180.2	99.9	266	232.6	129.0
27	23.6	13.1	87	76.1	42.2	147	128.6	71.3	207	181.0	100.4	267	233.5	129.4
28	24.5	13.6	88	77.0	42.7	148	129.4	71.8	208	181.9	100.8	268	234.4	129.9
29	25.4	14.1	89	77.8	43.1	149	130.3	72.2	209	182.8	101.3	269	235.3	130.4
30	26.2	14.5	90	78.7	43.6	150	131.2	72.7	210	183.7	101.8	270	236.1	130.9
31	27.1	15.0	91	79.6	44.1	151	132.1	73.2	211	184.5	102.3	271	237.0	131.4
32	28.0	15.5	92	80.5	44.6	152	132.9	73.7	212	185.4	102.8	272	237.9	131.9
33	28.9	16.0	93	81.3	45.1	153	133.8	74.2	213	186.3	103.3	273	238.8	132.4
34	29.7	16.5	94	82.2	45.6	154	134.7	74.7	214	187.2	103.7	274	239.6	132.8
35	30.6	17.0	95	83.1	46.1	155	135.6	75.1	215	188.0	104.2	275	240.5	133.3
36	31.5	17.5	96	84.0	46.5	156	136.4	75.6	216	188.9	104.7	276	241.4	133.8
37	32.4	17.9	97	84.8	47.0	157	137.3	76.1	217	189.8	105.2	277	242.3	134.3
38	33.2	18.4	98	85.7	47.5	158	138.2	76.6	218	190.7	105.7	278	243.1	134.8
39	34.1	18.9	99	86.6	48.0	159	139.1	77.1	219	191.5	106.2	279	244.0	135.3
40	35.0	19.4	100	87.5	48.5	160	139.9	77.6	220	192.4	106.7	280	244.9	135.7
41	35.9	19.9	101	88.3	49.0	161	140.8	78.1	221	193.3	107.1	281	245.8	136.2
42	36.7	20.4	102	89.2	49.5	162	141.7	78.5	222	194.2	107.6	282	246.6	136.7
43	37.6	20.8	103	90.1	49.9	163	142.6	79.0	223	195.0	108.1	283	247.5	137.2
44	38.5	21.3	104	91.0	50.4	164	143.4	79.5	224	195.9	108.6	284	248.4	137.7
45	39.4	21.8	105	91.8	50.9	165	144.3	80.0	225	196.8	109.1	285	249.3	138.2
46	40.2	22.3	106	92.7	51.4	166	145.2	80.5	226	197.7	109.6	286	250.1	138.7
47	41.1	22.8	107	93.6	51.9	167	146.1	81.0	227	198.5	110.1	287	251.0	139.1
48	42.0	23.3	108	94.5	52.4	168	146.9	81.4	228	199.4	110.5	288	251.9	139.6
49	42.9	23.8	109	95.3	52.8	169	147.8	81.9	229	200.3	111.0	289	252.8	140.1
50	43.7	24.2	110	96.2	53.3	170	148.7	82.4	230	201.2	111.5	290	253.6	140.6
51	44.6	24.7	111	97.1	53.8	171	149.6	82.9	231	202.0	112.0	291	254.5	141.1
52	45.5	25.2	112	98.0	54.3	172	150.4	83.4	232	202.9	112.5	292	255.4	141.6
53	46.4	25.7	113	98.8	54.8	173	151.3	83.9	233	203.8	113.0	293	256.3	142.0
54	47.2	26.2	114	99.7	55.3	174	152.2	84.4	234	204.7	113.4	294	257.1	142.5
55	48.1	26.7	115	100.6	55.8	175	153.1	84.8	235	205.5	113.9	295	258.0	143.0
56	49.0	27.1	116	101.5	56.2	176	153.9	85.3	236	206.4	114.4	296	258.9	143.5
57	49.9	27.6	117	102.3	56.7	177	154.8	85.8	237	207.3	114.9	297	259.8	144.0
58	50.7	28.1	118	103.2	57.2	178	155.7	86.3	238	208.2	115.4	298	260.6	144.5
59	51.6	28.6	119	104.1	57.7	179	156.6	86.8	239	209.0	115.9	299	261.5	145.0
60	52.5	29.1	120	105.0	58.2	180	157.4	87.3	240	209.9	116.4	300	262.4	145.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 61 Degrees.

TABLE II.

Difference of Latitude and Departure for 30 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	52.8	30.5	121	104.8	60.5	181	156.8	90.5	241	208.7	120.5
2	01.7	01.0	62	53.7	31.0	122	105.7	61.0	182	157.6	91.0	242	209.6	121.0
3	02.6	01.5	63	54.6	31.5	123	106.5	61.5	183	158.5	91.5	243	210.4	121.5
4	03.5	02.0	64	55.4	32.0	124	107.4	62.0	184	159.3	92.0	244	211.3	122.0
5	04.3	02.5	65	56.3	32.5	125	108.3	62.5	185	160.2	92.5	245	212.2	122.5
6	05.2	03.0	66	57.2	33.0	126	109.1	63.0	186	161.1	93.0	246	213.0	123.0
7	06.1	03.5	67	58.0	33.5	127	110.0	63.5	187	161.9	93.5	247	213.9	123.5
8	06.9	04.0	68	58.9	34.0	128	110.9	64.0	188	162.8	94.0	248	214.8	124.0
9	07.8	04.5	69	59.8	34.5	129	111.7	64.5	189	163.7	94.5	249	215.6	124.5
10	08.7	05.0	70	60.6	35.0	130	112.6	65.0	190	164.5	95.0	250	216.5	125.0
11	09.5	05.5	71	61.5	35.5	131	113.4	65.5	191	165.4	95.5	251	217.4	125.5
12	10.4	06.0	72	62.4	36.0	132	114.3	66.0	192	166.3	96.0	252	218.2	126.0
13	11.3	06.5	73	63.2	36.5	133	115.2	66.5	193	167.1	96.5	253	219.1	126.5
14	12.1	07.0	74	64.1	37.0	134	116.0	67.0	194	168.0	97.0	254	220.0	127.0
15	13.0	07.5	75	65.0	37.5	135	116.9	67.5	195	168.9	97.5	255	220.8	127.5
16	13.9	08.0	76	65.8	38.0	136	117.8	68.0	196	169.7	98.0	256	221.7	128.0
17	14.7	08.5	77	66.7	38.5	137	118.6	68.5	197	170.6	98.5	257	222.6	128.5
18	15.6	09.0	78	67.5	39.0	138	119.5	69.0	198	171.5	99.0	258	223.4	129.0
19	16.5	09.5	79	68.4	39.5	139	120.4	69.5	199	172.3	99.5	259	224.3	129.5
20	17.3	10.0	80	69.3	40.0	140	121.2	70.0	200	173.2	100.0	260	225.2	130.0
21	18.2	10.5	81	70.1	40.5	141	122.1	70.5	201	174.1	100.5	261	226.0	130.5
22	19.1	11.0	82	71.0	41.0	142	123.0	71.0	202	174.9	101.0	262	226.9	131.0
23	19.9	11.5	83	71.9	41.5	143	123.8	71.5	203	175.8	101.5	263	227.8	131.5
24	20.8	12.0	84	72.7	42.0	144	124.7	72.0	204	176.7	102.0	264	228.6	132.0
25	21.7	12.5	85	73.6	42.5	145	125.6	72.5	205	177.5	102.5	265	229.5	132.5
26	22.5	13.0	86	74.5	43.0	146	126.4	73.0	206	178.4	103.0	266	230.4	133.0
27	23.4	13.5	87	75.3	43.5	147	127.3	73.5	207	179.3	103.5	267	231.2	133.5
28	24.2	14.0	88	76.2	44.0	148	128.2	74.0	208	180.1	104.0	268	232.1	134.0
29	25.1	14.5	89	77.1	44.5	149	129.0	74.5	209	181.0	104.5	269	233.0	134.5
30	26.0	15.0	90	77.9	45.0	150	129.9	75.0	210	181.9	105.0	270	233.8	135.0
31	26.8	15.5	91	78.8	45.5	151	130.8	75.5	211	182.7	105.5	271	234.7	135.5
32	27.7	16.0	92	79.7	46.0	152	131.6	76.0	212	183.6	106.0	272	235.6	136.0
33	28.6	16.5	93	80.5	46.5	153	132.5	76.5	213	184.5	106.5	273	236.4	136.5
34	29.4	17.0	94	81.4	47.0	154	133.4	77.0	214	185.3	107.0	274	237.3	137.0
35	30.3	17.5	95	82.3	47.5	155	134.2	77.5	215	186.2	107.5	275	238.2	137.5
36	31.2	18.0	96	83.1	48.0	156	135.1	78.0	216	187.1	108.0	276	239.0	138.0
37	32.0	18.5	97	84.0	48.5	157	136.0	78.5	217	187.9	108.5	277	239.9	138.5
38	32.9	19.0	98	84.9	49.0	158	136.8	79.0	218	188.8	109.0	278	240.8	139.0
39	33.8	19.5	99	85.7	49.5	159	137.7	79.5	219	189.7	109.5	279	241.6	139.5
40	34.6	20.0	100	86.6	50.0	160	138.6	80.0	220	190.5	110.0	280	242.5	140.0
41	35.5	20.5	101	87.5	50.5	161	139.4	80.5	221	191.4	110.5	281	243.4	140.5
42	36.4	21.0	102	88.3	51.0	162	140.3	81.0	222	192.3	111.0	282	244.2	141.0
43	37.2	21.5	103	89.2	51.5	163	141.2	81.5	223	193.1	111.5	283	245.1	141.5
44	38.1	22.0	104	90.1	52.0	164	142.0	82.0	224	194.0	112.0	284	246.0	142.0
45	39.0	22.5	105	90.9	52.5	165	142.9	82.5	225	194.9	112.5	285	246.8	142.5
46	39.8	23.0	106	91.8	53.0	166	143.8	83.0	226	195.7	113.0	286	247.7	143.0
47	40.7	23.5	107	92.7	53.5	167	144.6	83.5	227	196.6	113.5	287	248.5	143.5
48	41.6	24.0	108	93.5	54.0	168	145.5	84.0	228	197.5	114.0	288	249.4	144.0
49	42.4	24.5	109	94.4	54.5	169	146.4	84.5	229	198.3	114.5	289	250.3	144.5
50	43.3	25.0	110	95.3	55.0	170	147.2	85.0	230	199.2	115.0	290	251.1	145.0
51	44.2	25.5	111	96.1	55.5	171	148.1	85.5	231	200.1	115.5	291	252.0	145.5
52	45.0	26.0	112	97.0	56.0	172	149.0	86.0	232	200.9	116.0	292	252.9	146.0
53	45.9	26.5	113	97.9	56.5	173	149.8	86.5	233	201.8	116.5	293	253.7	146.5
54	46.8	27.0	114	98.7	57.0	174	150.7	87.0	234	202.6	117.0	294	254.6	147.0
55	47.6	27.5	115	99.6	57.5	175	151.6	87.5	235	203.5	117.5	295	255.5	147.5
56	48.5	28.0	116	100.5	58.0	176	152.4	88.0	236	204.4	118.0	296	256.3	148.0
57	49.4	28.5	117	101.3	58.5	177	153.3	88.5	237	205.2	118.5	297	257.2	148.5
58	50.2	29.0	118	102.2	59.0	178	154.2	89.0	238	206.1	119.0	298	258.1	149.0
59	51.1	29.5	119	103.1	59.5	179	155.0	89.5	239	207.0	119.5	299	258.9	149.5
60	52.0	30.0	120	103.9	60.0	180	155.9	90.0	240	207.8	120.0	300	259.8	150.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 60 Degrees.

TABLE II.

Difference of Latitude and Departure for 31 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	52.3	31.4	121	103.7	62.3	181	155.1	93.2	241	206.6	124.1
2	01.7	01.0	62	53.1	31.9	122	104.6	62.8	182	156.0	93.7	242	207.4	124.6
3	02.6	01.5	63	54.0	32.4	123	105.4	63.3	183	156.9	94.3	243	208.3	125.2
4	03.4	02.1	64	54.9	33.0	124	106.3	63.9	184	157.7	94.8	244	209.1	125.7
5	04.3	02.6	65	55.7	33.5	125	107.1	64.4	185	158.6	95.3	245	210.0	126.2
6	05.1	03.1	66	56.6	34.0	126	108.0	64.9	186	159.4	95.8	246	210.9	126.7
7	06.0	03.6	67	57.4	34.5	127	108.9	65.4	187	160.3	96.3	247	211.7	127.2
8	06.9	04.1	68	58.3	35.0	128	109.7	65.9	188	161.1	96.8	248	212.6	127.7
9	07.7	04.6	69	59.1	35.5	129	110.6	66.4	189	162.0	97.3	249	213.4	128.2
10	08.6	05.2	70	60.0	36.1	130	111.4	67.0	190	162.9	97.9	250	214.3	128.8
11	09.4	05.7	71	60.9	36.6	131	112.3	67.5	191	163.7	98.4	251	215.1	129.3
12	10.3	06.2	72	61.7	37.1	132	113.1	68.0	192	164.6	98.9	252	216.0	129.8
13	11.1	06.7	73	62.6	37.6	133	114.0	68.5	193	165.4	99.4	253	216.9	130.3
14	12.0	07.2	74	63.4	38.1	134	114.9	69.0	194	166.3	99.9	254	217.7	130.8
15	12.9	07.7	75	64.3	38.6	135	115.7	69.5	195	167.1	100.4	255	218.6	131.3
16	13.7	08.2	76	65.1	39.1	136	116.6	70.0	196	168.0	100.9	256	219.4	131.8
17	14.6	08.8	77	66.0	39.7	137	117.4	70.6	197	168.9	101.5	257	220.3	132.4
18	15.4	09.3	78	66.9	40.2	138	118.3	71.1	198	169.7	102.0	258	221.1	132.9
19	16.3	09.8	79	67.7	40.7	139	119.1	71.6	199	170.6	102.5	259	222.0	133.4
20	17.1	10.3	80	68.6	41.2	140	120.0	72.1	200	171.4	103.0	260	222.9	133.9
21	18.0	10.8	81	69.4	41.7	141	120.9	72.6	201	172.3	103.5	261	223.7	134.4
22	18.9	11.3	82	70.3	42.2	142	121.7	73.1	202	173.1	104.0	262	224.6	134.9
23	19.7	11.8	83	71.1	42.7	143	122.6	73.7	203	174.0	104.6	263	225.4	135.5
24	20.6	12.4	84	72.0	43.3	144	123.4	74.2	204	174.9	105.1	264	226.3	136.0
25	21.4	12.9	85	72.9	43.8	145	124.3	74.7	205	175.7	105.6	265	227.1	136.5
26	22.3	13.4	86	73.7	44.3	146	125.1	75.2	206	176.6	106.1	266	228.0	137.0
27	23.1	13.9	87	74.6	44.8	147	126.0	75.7	207	177.4	106.6	267	228.9	137.5
28	24.0	14.4	88	75.4	45.3	148	126.9	76.2	208	178.3	107.1	268	229.7	138.0
29	24.9	14.9	89	76.3	45.8	149	127.7	76.7	209	179.1	107.6	269	230.6	138.5
30	25.7	15.5	90	77.1	46.4	150	128.6	77.3	210	180.0	108.2	270	231.4	139.1
31	26.6	16.0	91	78.0	46.9	151	129.4	77.8	211	180.9	108.7	271	232.3	139.6
32	27.4	16.5	92	78.9	47.4	152	130.3	78.3	212	181.7	109.2	272	233.1	140.1
33	28.3	17.0	93	79.7	47.9	153	131.1	78.8	213	182.6	109.7	273	234.0	140.6
34	29.1	17.5	94	80.6	48.4	154	132.0	79.3	214	183.4	110.2	274	234.9	141.1
35	30.0	18.0	95	81.4	48.9	155	132.9	79.8	215	184.3	110.7	275	235.7	141.6
36	30.9	18.5	96	82.3	49.4	156	133.7	80.3	216	185.1	111.2	276	236.6	142.2
37	31.7	19.1	97	83.1	50.0	157	134.6	80.9	217	186.0	111.8	277	237.4	142.7
38	32.6	19.6	98	84.0	50.5	158	135.4	81.4	218	186.9	112.3	278	238.3	143.2
39	33.4	20.1	99	84.9	51.0	159	136.3	81.9	219	187.7	112.8	279	239.1	143.7
40	34.3	20.6	100	85.7	51.5	160	137.1	82.4	220	188.6	113.3	280	240.0	144.2
41	35.1	21.1	101	86.6	52.0	161	138.0	82.9	221	189.4	113.8	281	240.9	144.7
42	36.0	21.6	102	87.4	52.5	162	138.9	83.4	222	190.3	114.3	282	241.7	145.2
43	36.9	22.1	103	88.3	53.0	163	139.7	84.0	223	191.1	114.9	283	242.6	145.8
44	37.7	22.7	104	89.1	53.6	164	140.6	84.5	224	192.0	115.4	284	243.4	146.3
45	38.6	23.2	105	90.0	54.1	165	141.4	85.0	225	192.9	115.9	285	244.3	146.8
46	39.4	23.7	106	90.9	54.6	166	142.3	85.5	226	193.7	116.4	286	245.1	147.3
47	40.3	24.2	107	91.7	55.1	167	143.1	86.0	227	194.6	116.9	287	246.0	147.8
48	41.1	24.7	108	92.6	55.6	168	144.0	86.5	228	195.4	117.4	288	246.9	148.3
49	42.0	25.2	109	93.4	56.1	169	144.9	87.0	229	196.3	117.9	289	247.7	148.8
50	42.9	25.8	110	94.3	56.7	170	145.7	87.6	230	197.1	118.5	290	248.6	149.4
51	43.7	26.3	111	95.1	57.2	171	146.6	88.1	231	198.0	119.0	291	249.4	149.9
52	44.6	26.8	112	96.0	57.7	172	147.4	88.6	232	198.9	119.5	292	250.3	150.4
53	45.4	27.3	113	96.9	58.2	173	148.3	89.1	233	199.7	120.0	293	251.2	150.9
54	46.3	27.8	114	97.7	58.7	174	149.1	89.6	234	200.6	120.5	294	252.0	151.4
55	47.1	28.3	115	98.6	59.2	175	150.0	90.1	235	201.4	121.0	295	252.9	151.9
56	48.0	28.8	116	99.4	59.7	176	150.9	90.6	236	202.3	121.5	296	253.7	152.5
57	48.9	29.4	117	100.3	60.3	177	151.7	91.2	237	203.1	122.1	297	254.6	153.0
58	49.7	29.9	118	101.1	60.8	178	152.6	91.7	238	204.0	122.6	298	255.4	153.5
59	50.6	30.4	119	102.0	61.3	179	153.4	92.2	239	204.9	123.1	299	256.3	154.0
60	51.4	30.9	120	102.9	61.8	180	154.3	92.7	240	205.7	123.6	300	257.1	154.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 59 Degrees.

TABLE II.

Difference of Latitude and Departure for 32 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.5	61	51.7	32.3	121	102.6	64.1	181	153.5	95.9	241	204.4	127.7
2	01.7	01.1	62	52.6	32.9	122	103.5	64.7	182	154.3	96.4	242	205.2	128.2
3	02.5	01.6	63	53.4	33.4	123	104.3	65.2	183	155.2	97.0	243	206.1	128.8
4	03.4	02.1	64	54.3	33.9	124	105.2	65.7	184	156.0	97.5	244	206.9	129.3
5	04.2	02.6	65	55.1	34.4	125	106.0	66.2	185	156.9	98.0	245	207.8	129.8
6	05.1	03.2	66	56.0	35.0	126	106.9	66.8	186	157.7	98.6	246	208.6	130.4
7	05.9	03.7	67	56.8	35.5	127	107.7	67.3	187	158.6	99.1	247	209.5	130.9
8	06.8	04.2	68	57.7	36.0	128	108.6	67.8	188	159.4	99.6	248	210.3	131.4
9	07.6	04.8	69	58.5	36.6	129	109.4	68.4	189	160.3	100.2	249	211.2	131.9
10	08.5	05.3	70	59.4	37.1	130	110.2	68.9	190	161.1	100.7	250	212.0	132.5
11	09.3	05.8	71	60.2	37.6	131	111.1	69.4	191	162.0	101.2	251	212.9	133.0
12	10.2	06.4	72	61.1	38.2	132	111.9	69.9	192	162.8	101.7	252	213.7	133.5
13	11.0	06.9	73	61.9	38.7	133	112.8	70.5	193	163.7	102.3	253	214.6	134.1
14	11.9	07.4	74	62.8	39.2	134	113.6	71.0	194	164.5	102.8	254	215.4	134.6
15	12.7	07.9	75	63.6	39.7	135	114.5	71.5	195	165.4	103.3	255	216.3	135.1
16	13.6	08.5	76	64.5	40.3	136	115.3	72.1	196	166.2	103.9	256	217.1	135.7
17	14.4	09.0	77	65.3	40.8	137	116.2	72.6	197	167.1	104.4	257	217.9	136.2
18	15.3	09.5	78	66.1	41.3	138	117.0	73.1	198	167.9	104.9	258	218.8	136.7
19	16.1	10.1	79	67.0	41.9	139	117.9	73.7	199	168.8	105.5	259	219.6	137.2
20	17.0	10.6	80	67.8	42.4	140	118.7	74.2	200	169.6	106.0	260	220.5	137.8
21	17.8	11.1	81	68.7	42.9	141	119.6	74.7	201	170.5	106.5	261	221.3	138.3
22	18.7	11.7	82	69.5	43.5	142	120.4	75.2	202	171.3	107.0	262	222.2	138.8
23	19.5	12.2	83	70.4	44.0	143	121.3	75.8	203	172.2	107.6	263	223.0	139.4
24	20.4	12.7	84	71.2	44.5	144	122.1	76.3	204	173.0	108.1	264	223.9	139.9
25	21.2	13.2	85	72.1	45.0	145	123.0	76.8	205	173.8	108.6	265	224.7	140.4
26	22.0	13.8	86	72.9	45.6	146	123.8	77.4	206	174.7	109.2	266	225.6	141.0
27	22.9	14.3	87	73.8	46.1	147	124.7	77.9	207	175.5	109.7	267	226.4	141.5
28	23.7	14.8	88	74.6	46.6	148	125.5	78.4	208	176.4	110.2	268	227.3	142.0
29	24.6	15.4	89	75.5	47.2	149	126.4	79.0	209	177.2	110.8	269	228.1	142.5
30	25.4	15.9	90	76.3	47.7	150	127.2	79.5	210	178.1	111.3	270	229.0	143.1
31	26.3	16.4	91	77.2	48.2	151	128.1	80.0	211	178.9	111.8	271	229.8	143.6
32	27.1	17.0	92	78.0	48.8	152	128.9	80.5	212	179.8	112.3	272	230.7	144.1
33	28.0	17.5	93	78.9	49.3	153	129.8	81.1	213	180.6	112.9	273	231.5	144.7
34	28.8	18.0	94	79.7	49.8	154	130.6	81.6	214	181.5	113.4	274	232.4	145.2
35	29.7	18.5	95	80.6	50.3	155	131.4	82.1	215	182.3	113.9	275	233.2	145.7
36	30.5	19.1	96	81.4	50.9	156	132.3	82.7	216	183.2	114.5	276	234.1	146.3
37	31.4	19.6	97	82.3	51.4	157	133.1	83.2	217	184.0	115.0	277	234.9	146.8
38	32.2	20.1	98	83.1	51.9	158	134.0	83.7	218	184.9	115.5	278	235.8	147.3
39	33.1	20.7	99	84.0	52.5	159	134.8	84.3	219	185.7	116.1	279	236.6	147.8
40	33.9	21.2	100	84.8	53.0	160	135.7	84.8	220	186.6	116.6	280	237.5	148.4
41	34.8	21.7	101	85.7	53.5	161	136.5	85.3	221	187.4	117.1	281	238.3	148.9
42	35.6	22.3	102	86.5	54.1	162	137.4	85.8	222	188.3	117.6	282	239.1	149.4
43	36.5	22.8	103	87.3	54.6	163	138.2	86.4	223	189.1	118.2	283	240.0	150.0
44	37.3	23.3	104	88.2	55.1	164	139.1	86.9	224	190.0	118.7	284	240.8	150.5
45	38.2	23.8	105	89.0	55.6	165	139.9	87.4	225	190.8	119.2	285	241.7	151.0
46	39.0	24.4	106	89.9	56.2	166	140.8	88.0	226	191.7	119.8	286	242.5	151.6
47	39.9	24.9	107	90.7	56.7	167	141.6	88.5	227	192.5	120.3	287	243.4	152.1
48	40.7	25.4	108	91.6	57.2	168	142.5	89.0	228	193.4	120.8	288	244.2	152.6
49	41.6	26.0	109	92.4	57.8	169	143.3	89.6	229	194.2	121.4	289	245.1	153.1
50	42.4	26.5	110	93.3	58.3	170	144.2	90.1	230	195.1	121.9	290	245.9	153.7
51	43.3	27.0	111	94.1	58.8	171	145.0	90.6	231	195.9	122.4	291	246.8	154.2
52	44.1	27.6	112	95.0	59.4	172	145.9	91.1	232	196.7	122.9	292	247.6	154.7
53	44.9	28.1	113	95.8	59.9	173	146.7	91.7	233	197.6	123.5	293	248.5	155.3
54	45.8	28.6	114	96.7	60.4	174	147.6	92.2	234	198.4	124.0	294	249.3	155.8
55	46.6	29.1	115	97.5	60.9	175	148.4	92.7	235	199.3	124.5	295	250.2	156.3
56	47.5	29.7	116	98.4	61.5	176	149.3	93.3	236	200.1	125.1	296	251.0	156.9
57	48.3	30.2	117	99.2	62.0	177	150.1	93.8	237	201.0	125.6	297	251.9	157.4
58	49.2	30.7	118	100.1	62.5	178	151.0	94.3	238	201.8	126.1	298	252.7	157.9
59	50.0	31.3	119	100.9	63.1	179	151.8	94.9	239	202.7	126.7	299	253.6	158.4
60	50.9	31.8	120	101.8	63.6	180	152.6	95.4	240	203.5	127.2	300	254.4	159.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 58 Degrees.

TABLE II.

Difference of Latitude and Departure for 33 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.5	61	51.2	33.2	121	101.5	65.9	181	151.8	98.6	241	202.1	131.3
2	01.7	01.1	62	52.0	33.8	122	102.3	66.4	182	152.6	99.1	242	203.0	131.8
3	02.5	01.6	63	52.8	34.3	123	103.2	67.0	183	153.5	99.7	243	203.8	132.3
4	03.4	02.2	64	53.7	34.9	124	104.0	67.5	184	154.3	100.2	244	204.6	132.9
5	04.2	02.7	65	54.5	35.4	125	104.8	68.1	185	155.2	100.8	245	205.5	133.4
6	05.0	03.3	66	55.4	35.9	126	105.7	68.6	186	156.0	101.3	246	206.3	134.0
7	05.9	03.8	67	56.2	36.5	127	106.5	69.2	187	156.8	101.8	247	207.2	134.5
8	06.7	04.4	68	57.0	37.0	128	107.3	69.7	188	157.7	102.4	248	208.0	135.1
9	07.5	04.9	69	57.9	37.6	129	108.2	70.3	189	158.5	102.9	249	208.8	135.6
10	08.4	05.4	70	58.7	38.1	130	109.0	70.8	190	159.3	103.5	250	209.7	136.2
11	09.2	06.0	71	59.5	38.7	131	109.9	71.3	191	160.2	104.0	251	210.5	136.7
12	10.1	06.5	72	60.4	39.2	132	110.7	71.9	192	161.0	104.6	252	211.3	137.2
13	10.9	07.1	73	61.2	39.8	133	111.5	72.4	193	161.9	105.1	253	212.2	137.8
14	11.7	07.6	74	62.1	40.3	134	112.4	73.0	194	162.7	105.7	254	213.0	138.3
15	12.6	08.2	75	62.9	40.8	135	113.2	73.5	195	163.5	106.2	255	213.9	138.9
16	13.4	08.7	76	63.7	41.4	136	114.1	74.1	196	164.4	106.7	256	214.7	139.4
17	14.3	09.3	77	64.6	41.9	137	114.9	74.6	197	165.2	107.3	257	215.5	140.0
18	15.1	09.8	78	65.4	42.5	138	115.7	75.2	198	166.1	107.8	258	216.4	140.5
19	15.9	10.3	79	66.3	43.0	139	116.6	75.7	199	166.9	108.4	259	217.2	141.1
20	16.8	10.9	80	67.1	43.6	140	117.4	76.2	200	167.7	108.9	260	218.1	141.6
21	17.6	11.4	81	67.9	44.1	141	118.3	76.8	201	168.6	109.5	261	218.9	142.2
22	18.5	12.0	82	68.8	44.7	142	119.1	77.3	202	169.4	110.0	262	219.7	142.7
23	19.3	12.5	83	69.6	45.2	143	119.9	77.9	203	170.3	110.6	263	220.6	143.2
24	20.1	13.1	84	70.4	45.7	144	120.8	78.4	204	171.1	111.1	264	221.4	143.8
25	21.0	13.6	85	71.3	46.3	145	121.6	79.0	205	171.9	111.7	265	222.2	144.3
26	21.8	14.2	86	72.1	46.8	146	122.4	79.5	206	172.8	112.2	266	223.1	144.9
27	22.6	14.7	87	73.0	47.4	147	123.3	80.1	207	173.6	112.7	267	223.9	145.4
28	23.5	15.2	88	73.8	47.9	148	124.1	80.6	208	174.4	113.3	268	224.8	146.0
29	24.3	15.8	89	74.6	48.5	149	125.0	81.2	209	175.3	113.8	269	225.6	146.5
30	25.2	10.3	90	75.5	49.0	150	125.8	81.7	210	176.1	114.4	270	226.4	147.1
31	26.0	16.9	91	76.3	49.6	151	126.6	82.2	211	177.0	114.9	271	227.3	147.6
32	26.8	17.4	92	77.2	50.1	152	127.5	82.8	212	177.8	115.5	272	228.1	148.1
33	27.7	18.0	93	78.0	50.7	153	128.3	83.3	213	178.6	116.0	273	229.0	148.7
34	28.5	18.5	94	78.8	51.2	154	129.2	83.9	214	179.5	116.6	274	229.8	149.2
35	29.4	19.1	95	79.7	51.7	155	130.0	84.4	215	180.3	117.1	275	230.6	149.8
36	30.2	19.6	96	80.5	52.3	156	130.8	85.0	216	181.2	117.6	276	231.5	150.3
37	31.0	20.2	97	81.4	52.8	157	131.7	85.5	217	182.0	118.2	277	232.3	150.9
38	31.9	20.7	98	82.2	53.4	158	132.5	86.1	218	182.8	118.7	278	233.2	151.4
39	32.7	21.2	99	83.0	53.9	159	133.3	86.6	219	183.7	119.3	279	234.0	152.0
40	33.5	21.8	100	83.9	54.5	160	134.2	87.1	220	184.5	119.8	280	234.8	152.5
41	34.4	22.3	101	84.7	55.0	161	135.0	87.7	221	185.3	120.4	281	235.7	153.0
42	35.2	22.9	102	85.5	55.6	162	135.9	88.2	222	186.2	120.9	282	236.5	153.6
43	36.1	23.4	103	86.4	56.1	163	136.7	88.8	223	187.0	121.5	283	237.3	154.1
44	36.9	24.0	104	87.2	56.6	164	137.5	89.3	224	187.9	122.0	284	238.2	154.7
45	37.7	24.5	105	88.1	57.2	165	138.4	89.9	225	188.7	122.5	285	239.0	155.2
46	38.6	25.1	106	88.9	57.7	166	139.2	90.4	226	189.5	123.1	286	239.9	155.8
47	39.4	25.6	107	89.7	58.3	167	140.1	91.0	227	190.4	123.6	287	240.7	156.3
48	40.3	26.1	108	90.6	58.8	168	140.9	91.5	228	191.2	124.2	288	241.5	156.9
49	41.1	26.7	109	91.4	59.4	169	141.7	92.0	229	192.1	124.7	289	242.4	157.4
50	41.9	27.2	110	92.3	59.9	170	142.6	92.6	230	192.9	125.3	290	243.2	157.9
51	42.8	27.8	111	93.1	60.5	171	143.4	93.1	231	193.7	125.8	291	244.1	158.5
52	43.6	28.3	112	93.9	61.0	172	144.3	93.7	232	194.6	126.4	292	244.9	159.0
53	44.4	28.9	113	94.8	61.5	173	145.1	94.2	233	195.4	126.9	293	245.7	159.6
54	45.3	29.4	114	95.6	62.1	174	145.9	94.8	234	196.2	127.4	294	246.6	160.1
55	46.1	30.0	115	96.4	62.6	175	146.8	95.3	235	197.1	128.0	295	247.4	160.7
56	47.0	30.5	116	97.3	63.2	176	147.6	95.9	236	197.9	128.5	296	248.2	161.2
57	47.8	31.0	117	98.1	63.7	177	148.4	96.4	237	198.8	129.1	297	249.1	161.8
58	48.6	31.6	118	99.0	64.3	178	149.3	96.9	238	199.6	129.6	298	249.9	162.3
59	49.5	32.1	119	99.8	64.8	179	150.1	97.5	239	200.4	130.2	299	250.8	162.8
60	50.3	32.7	120	100.6	65.4	180	151.0	98.0	240	201.3	130.7	300	251.6	163.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 57 Degrees.

TABLE II.

Difference of Latitude and Departure for 34 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	50.6	34.1	121	100.3	67.7	181	150.1	101.2	241	199.8	134.8
2	01.7	01.1	62	51.4	34.7	122	101.1	68.2	182	150.9	101.8	242	200.6	135.3
3	02.5	01.7	63	52.2	35.2	123	102.0	68.8	183	151.7	102.3	243	201.5	135.9
4	03.3	02.2	64	53.1	35.8	124	102.8	69.3	184	152.5	102.9	244	202.3	136.4
5	04.1	02.8	65	53.9	36.3	125	103.6	69.9	185	153.4	103.5	245	203.1	137.0
6	05.0	03.4	66	54.7	36.9	126	104.5	70.5	186	154.2	104.0	246	203.9	137.6
7	05.8	03.9	67	55.5	37.5	127	105.3	71.0	187	155.0	104.6	247	204.8	138.1
8	06.6	04.5	68	56.4	38.0	128	106.1	71.6	188	155.9	105.1	248	205.6	138.7
9	07.5	05.0	69	57.2	38.6	129	106.9	72.1	189	156.7	105.7	249	206.4	139.2
10	08.3	05.6	70	58.0	39.1	130	107.8	72.7	190	157.5	106.2	250	207.3	139.8
11	09.1	06.2	71	58.9	39.7	131	108.6	73.3	191	158.3	106.8	251	208.1	140.4
12	09.9	06.7	72	59.7	40.3	132	109.4	73.8	192	159.2	107.4	252	208.9	140.9
13	10.8	07.3	73	60.5	40.8	133	110.3	74.4	193	160.0	107.9	253	209.7	141.5
14	11.6	07.8	74	61.3	41.4	134	111.1	74.9	194	160.8	108.5	254	210.6	142.0
15	12.4	08.4	75	62.2	41.9	135	111.9	75.5	195	161.7	109.0	255	211.4	142.6
16	13.3	08.9	76	63.0	42.5	136	112.7	76.1	196	162.5	109.6	256	212.2	143.2
17	14.1	09.5	77	63.8	43.1	137	113.6	76.6	197	163.3	110.2	257	213.1	143.7
18	14.9	10.1	78	64.7	43.6	138	114.4	77.2	198	164.1	110.7	258	213.9	144.3
19	15.8	10.6	79	65.5	44.2	139	115.2	77.7	199	165.0	111.3	259	214.7	144.8
20	16.6	11.2	80	66.3	44.7	140	116.1	78.3	200	165.8	111.8	260	215.5	145.4
21	17.4	11.7	81	67.2	45.3	141	116.9	78.8	201	166.6	112.4	261	216.4	145.9
22	18.2	12.3	82	68.0	45.9	142	117.7	79.4	202	167.5	113.0	262	217.2	146.5
23	19.1	12.9	83	68.8	46.4	143	118.6	80.0	203	168.3	113.5	263	218.0	147.1
24	19.9	13.4	84	69.6	47.0	144	119.4	80.5	204	169.1	114.1	264	218.9	147.6
25	20.7	14.0	85	70.5	47.5	145	120.2	81.1	205	170.0	114.6	265	219.7	148.2
26	21.6	14.5	86	71.3	48.1	146	121.0	81.6	206	170.8	115.2	266	220.5	148.7
27	22.4	15.1	87	72.1	48.6	147	121.9	82.2	207	171.6	115.8	267	221.4	149.3
28	23.2	15.7	88	73.0	49.2	148	122.7	82.8	208	172.4	116.3	268	222.2	149.9
29	24.0	16.2	89	73.8	49.8	149	123.5	83.3	209	173.3	116.9	269	223.0	150.4
30	24.9	16.8	90	74.6	50.3	150	124.4	83.9	210	174.1	117.4	270	223.8	151.0
31	25.7	17.3	91	75.4	50.9	151	125.2	84.4	211	174.9	118.0	271	224.7	151.5
32	26.5	17.9	92	76.3	51.4	152	126.0	85.0	212	175.8	118.5	272	225.5	152.1
33	27.4	18.5	93	77.1	52.0	153	126.8	85.6	213	176.6	119.1	273	226.3	152.7
34	28.2	19.0	94	77.9	52.6	154	127.7	86.1	214	177.4	119.7	274	227.2	153.2
35	29.0	19.6	95	78.8	53.1	155	128.5	86.7	215	178.2	120.2	275	228.0	153.8
36	29.8	20.1	96	79.6	53.7	156	129.3	87.2	216	179.1	120.8	276	228.8	154.3
37	30.7	20.7	97	80.4	54.2	157	130.2	87.8	217	179.9	121.3	277	229.6	154.9
38	31.5	21.2	98	81.2	54.8	158	131.0	88.4	218	180.7	121.9	278	230.5	155.5
39	32.3	21.8	99	82.1	55.4	159	131.8	88.9	219	181.6	122.5	279	231.3	156.0
40	33.2	22.4	100	82.9	55.9	160	132.6	89.5	220	182.4	123.0	280	232.1	156.6
41	34.0	22.9	101	83.7	56.5	161	133.5	90.0	221	183.2	123.6	281	233.0	157.1
42	34.8	23.5	102	84.6	57.0	162	134.3	90.6	222	184.0	124.1	282	233.8	157.7
43	35.6	24.0	103	85.4	57.6	163	135.1	91.1	223	184.9	124.7	283	234.6	158.3
44	36.5	24.6	104	86.2	58.2	164	136.0	91.7	224	185.7	125.3	284	235.4	158.8
45	37.3	25.2	105	87.0	58.7	165	136.8	92.3	225	186.5	125.8	285	236.3	159.4
46	38.1	25.7	106	87.9	59.3	166	137.6	92.8	226	187.4	126.4	286	237.1	159.9
47	39.0	26.3	107	88.7	59.8	167	138.4	93.4	227	188.2	126.9	287	237.9	160.5
48	39.8	26.8	108	89.5	60.4	168	139.3	93.9	228	189.0	127.5	288	238.8	161.0
49	40.6	27.4	109	90.4	61.0	169	140.1	94.5	229	189.8	128.1	289	239.6	161.6
50	41.5	28.0	110	91.2	61.5	170	140.9	95.1	230	190.7	128.6	290	240.4	162.2
51	42.3	28.5	111	92.0	62.1	171	141.8	95.6	231	191.5	129.2	291	241.2	162.7
52	43.1	29.1	112	92.9	62.6	172	142.6	96.2	232	192.3	129.7	292	242.1	163.3
53	43.9	29.6	113	93.7	63.2	173	143.4	96.7	233	193.2	130.3	293	242.9	163.8
54	44.8	30.2	114	94.5	63.7	174	144.3	97.3	234	194.0	130.9	294	243.7	164.4
55	45.6	30.8	115	95.3	64.3	175	145.1	97.9	235	194.8	131.4	295	244.6	165.0
56	46.4	31.3	116	96.2	64.9	176	145.9	98.4	236	195.7	132.0	296	245.4	165.5
57	47.3	31.9	117	97.0	65.4	177	146.7	99.0	237	196.5	132.5	297	246.2	166.1
58	48.1	32.4	118	97.8	66.0	178	147.6	99.5	238	197.3	133.1	298	247.1	166.6
59	48.9	33.0	119	98.7	66.5	179	148.4	100.1	239	198.1	133.6	299	247.9	167.2
60	49.7	33.6	120	99.5	67.1	180	149.2	100.7	240	199.0	134.2	300	248.7	167.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 56 Degrees.

TABLE II.

Difference of Latitude and Departure for 35 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	50.0	35.0	121	99.1	69.4	181	148.3	103.8	241	197.4	138.2
2	01.6	01.1	62	50.8	35.6	122	99.9	70.0	182	149.1	104.4	242	198.2	138.8
3	02.5	01.7	63	51.6	36.1	123	100.8	70.5	183	149.9	105.0	243	199.1	139.4
4	03.3	02.3	64	52.4	36.7	124	101.6	71.1	184	150.7	105.5	244	199.9	140.0
5	04.1	02.9	65	53.2	37.3	125	102.4	71.7	185	151.5	106.1	245	200.7	140.5
6	04.9	03.4	66	54.1	37.9	126	103.2	72.3	186	152.4	106.7	246	201.5	141.1
7	05.7	04.0	67	54.9	38.4	127	104.0	72.8	187	153.2	107.3	247	202.3	141.7
8	06.6	04.6	68	55.7	39.0	128	104.9	73.4	188	154.0	107.8	248	203.1	142.2
9	07.4	05.2	69	56.5	39.6	129	105.7	74.0	189	154.8	108.4	249	204.0	142.8
10	08.2	05.7	70	57.3	40.2	130	106.5	74.6	190	155.6	109.0	250	204.8	143.4
11	09.0	06.3	71	58.2	40.7	131	107.3	75.1	191	156.5	109.6	251	205.6	144.0
12	09.8	06.9	72	59.0	41.3	132	108.1	75.7	192	157.3	110.1	252	206.4	144.5
13	10.6	07.5	73	59.8	41.9	133	108.9	76.3	193	158.1	110.7	253	207.2	145.1
14	11.5	08.0	74	60.6	42.4	134	109.8	76.9	194	158.9	111.3	254	208.1	145.7
15	12.3	08.6	75	61.4	43.0	135	110.6	77.4	195	159.7	111.8	255	208.9	146.3
16	13.1	09.2	76	62.3	43.6	136	111.4	78.0	196	160.6	112.4	256	209.7	146.8
17	13.9	09.8	77	63.1	44.2	137	112.2	78.6	197	161.4	113.0	257	210.5	147.4
18	14.7	10.3	78	63.9	44.7	138	113.0	79.2	198	162.2	113.6	258	211.3	148.0
19	15.6	10.9	79	64.7	45.3	139	113.9	79.7	199	163.0	114.1	259	212.2	148.6
20	16.4	11.5	80	65.5	45.9	140	114.7	80.3	200	163.8	114.7	260	213.0	149.1
21	17.2	12.0	81	66.4	46.5	141	115.5	80.9	201	164.6	115.3	261	213.8	149.7
22	18.0	12.6	82	67.2	47.0	142	116.3	81.4	202	165.5	115.9	262	214.6	150.3
23	18.8	13.2	83	68.0	47.6	143	117.1	82.0	203	166.3	116.4	263	215.4	150.9
24	19.7	13.8	84	68.8	48.2	144	118.0	82.6	204	167.1	117.0	264	216.3	151.4
25	20.5	14.3	85	69.6	48.8	145	118.8	83.2	205	167.9	117.6	265	217.1	152.0
26	21.3	14.9	86	70.4	49.3	146	119.6	83.7	206	168.7	118.2	266	217.9	152.6
27	22.1	15.5	87	71.3	49.9	147	120.4	84.3	207	169.6	118.7	267	218.7	153.1
28	22.9	16.1	88	72.1	50.5	148	121.2	84.9	208	170.4	119.3	268	219.5	153.7
29	23.8	16.6	89	72.9	51.0	149	122.1	85.5	209	171.2	119.9	269	220.4	154.3
30	24.6	17.2	90	73.7	51.6	150	122.9	86.0	210	172.0	120.5	270	221.2	154.9
31	25.4	17.8	91	74.5	52.2	151	123.7	86.6	211	172.8	121.0	271	222.0	155.4
32	26.2	18.4	92	75.4	52.8	152	124.5	87.2	212	173.7	121.6	272	222.8	156.0
33	27.0	18.9	93	76.2	53.3	153	125.3	87.8	213	174.5	122.2	273	223.6	156.6
34	27.9	19.5	94	77.0	53.9	154	126.1	88.3	214	175.3	122.7	274	224.4	157.2
35	28.7	20.1	95	77.8	54.5	155	127.0	88.9	215	176.1	123.3	275	225.3	157.7
36	29.5	20.6	96	78.6	55.1	156	127.8	89.5	216	176.9	123.9	276	226.1	158.3
37	30.3	21.2	97	79.5	55.6	157	128.6	90.1	217	177.8	124.5	277	226.9	158.9
38	31.1	21.8	98	80.3	56.2	158	129.4	90.6	218	178.6	125.0	278	227.7	159.5
39	31.9	22.4	99	81.1	56.8	159	130.2	91.2	219	179.4	125.6	279	228.5	160.0
40	32.8	22.9	100	81.9	57.4	160	131.1	91.8	220	180.2	126.2	280	229.4	160.6
41	33.6	23.5	101	82.7	57.9	161	131.9	92.3	221	181.0	126.8	281	230.2	161.2
42	34.4	24.1	102	83.6	58.5	162	132.7	92.9	222	181.9	127.3	282	231.0	161.7
43	35.2	24.7	103	84.4	59.1	163	133.5	93.5	223	182.7	127.9	283	231.8	162.3
44	36.0	25.2	104	85.2	59.7	164	134.3	94.1	224	183.5	128.5	284	232.6	162.9
45	36.9	25.8	105	86.0	60.2	165	135.2	94.6	225	184.3	129.1	285	233.5	163.5
46	37.7	26.4	106	86.8	60.8	166	136.0	95.2	226	185.1	129.6	286	234.3	164.0
47	38.5	27.0	107	87.6	61.4	167	136.8	95.8	227	185.9	130.2	287	235.1	164.6
48	39.3	27.5	108	88.5	61.9	168	137.6	96.4	228	186.8	130.8	288	235.9	165.2
49	40.1	28.1	109	89.3	62.5	169	138.4	96.9	229	187.6	131.3	289	236.7	165.8
50	41.0	28.7	110	90.1	63.1	170	139.3	97.5	230	188.4	131.9	290	237.6	166.3
51	41.8	29.3	111	90.9	63.7	171	140.1	98.1	231	189.2	132.5	291	238.4	166.9
52	42.6	29.8	112	91.7	64.2	172	140.9	98.7	232	190.0	133.1	292	239.2	167.5
53	43.4	30.4	113	92.6	64.8	173	141.7	99.2	233	190.9	1[illegible].6	293	240.0	168.1
54	44.2	31.0	114	93.4	65.4	174	142.5	99.8	234	191.7	134.2	294	240.8	168.6
55	45.1	31.5	115	94.2	66.0	175	143.4	100.4	235	192.5	[illegible].8	295	241.6	169.2
56	45.9	32.1	116	95.0	66.5	176	144.2	100.9	236	193.3	135.4	296	242.5	169.8
57	46.7	32.7	117	95.8	67.1	177	145.0	101.5	237	194.1	135.9	297	243.3	170.4
58	47.5	33.3	118	96.7	67.7	178	145.8	102.1	238	195.0	136.5	298	244.1	170.9
59	48.3	33.8	119	97.5	68.3	179	146.6	102.7	239	195.8	137.1	299	244.9	171.5
60	49.1	34.4	120	98.3	68.8	180	147.4	103.2	240	196.6	137.7	300	245.7	172.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 55 Degrees.

TABLE II.

Difference of Latitude and Departure for 36 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	49.4	35.9	121	97.9	71.1	181	146.4	106.4	241	195.0	141.7
2	01.6	01.2	62	50.2	36.4	122	98.7	71.7	182	147.2	107.0	242	195.8	142.2
3	02.4	01.8	63	51.0	37.0	123	99.5	72.3	183	148.1	107.6	243	196.6	142.8
4	03.2	02.4	64	51.8	37.6	124	100.3	72.9	184	148.9	108.2	244	197.4	143.4
5	04.0	02.9	65	52.6	38.2	125	101.1	73.5	185	149.7	108.7	245	198.2	144.0
6	04.9	03.5	66	53.4	38.8	126	101.9	74.1	186	150.5	109.3	246	199.0	144.6
7	05.7	04.1	67	54.2	39.4	127	102.7	74.6	187	151.3	109.9	247	199.8	145.2
8	06.5	04.7	68	55.0	40.0	128	103.6	75.2	188	152.1	110.5	248	200.6	145.8
9	07.3	05.3	69	55.8	40.6	129	104.4	75.8	189	152.9	111.1	249	201.4	146.4
10	08.1	05.9	70	56.6	41.1	130	105.2	76.4	190	153.7	111.7	250	202.3	146.9
11	08.9	06.5	71	57.4	41.7	131	106.0	77.0	191	154.5	112.3	251	203.1	147.5
12	09.7	07.1	72	58.2	42.3	132	106.8	77.6	192	155.3	112.9	252	203.9	148.1
13	10.5	07 6	73	59.1	42.9	133	107.6	78.2	193	156.1	113.4	253	204.7	148.7
14	11.3	08.2	74	59.9	43.5	134	108.4	78.8	194	156.9	114.0	254	205.5	149.3
15	12.1	08.8	75	60.7	44.1	135	109.2	79.4	195	157.8	114.6	255	206.3	149.9
16	12.9	09.4	76	61.5	44.7	136	110.0	79.9	196	158.6	115.2	256	207.1	150.5
17	13.8	10.0	77	62.3	45.3	137	110.8	80.5	197	159.4	115.8	257	207.9	151.1
18	14.6	10.6	78	63.1	45.8	138	111.6	81.1	198	160.2	116.4	258	208.7	151.6
19	15.4	11.2	79	63.9	46.4	139	112.5	81.7	199	161.0	117.0	259	209.5	152.2
20	16.2	11.8	80	64.7	47.0	140	113.3	82.3	200	161.8	117.6	260	210.3	152.8
21	17.0	12.3	81	65.5	47.6	141	114.1	82.9	201	162.6	118.1	261	211.2	153.4
22	17.8	12.9	82	66.3	48.2	142	114.9	83.5	202	163.4	118.7	262	212.0	154.0
23	18.6	13.5	83	67.1	48.8	143	115.7	84.1	203	164.2	119.3	263	212.8	154.6
24	19.4	14.1	84	68.0	49.4	144	116.5	84.6	204	165.0	119.9	264	213.6	155.2
25	20.2	14.7	85	68.8	50.0	145	117.3	85.2	205	165.8	120.5	265	214.4	155.8
26	21.0	15.3	86	69.6	50.5	146	118.1	85.8	206	166.7	121.1	266	215.2	156.4
27	21.8	15.9	87	70.4	51.1	147	118.9	86.4	207	167.5	121.7	267	216.0	156.9
28	22.7	16.5	88	71.2	51.7	148	119.7	87.0	208	168.3	122.3	268	216.8	157.5
29	23.5	17.0	89	72.0	52.3	149	120.5	87.6	209	169.1	122.8	269	217.6	158.1
30	24.3	17.6	90	72.8	52.9	150	121.4	88.2	210	169.9	123 4	270	218.4	158.7
31	25.1	18.2	91	73.6	53.5	151	122.2	88.8	211	170.7	124.0	271	219.2	159.3
32	25.9	18.8	92	74.4	54.1	152	123.0	89.3	212	171.5	124.6	272	220.1	159.9
33	26.7	19.4	93	75.2	54.7	153	123.8	89.9	213	172.3	125.2	273	220.9	160.5
34	27.5	20.0	94	76.0	55.3	154	124.6	90.5	214	173.1	125.8	274	221.7	161.1
35	28.3	20.6	95	76.9	55.8	155	125.4	91.1	215	173.9	126.4	275	222.5	161.6
36	29.1	21.2	96	77.7	56.4	156	126.2	91.7	216	174.7	127.0	276	223.3	162.2
37	29.9	21.7	97	78.5	57.0	157	127.0	92.3	217	175.6	127.5	277	224.1	162.8
38	30.7	22.3	98	79.3	57.6	158	127.8	92.9	218	176.4	128.1	278	224.9	163.4
39	31.6	22.9	99	80.1	58.2	159	128.6	93.5	219	177.2	128.7	279	225.7	164.0
40	32.4	23.5	100	80.9	58.8	160	129.4	94.0	220	178.0	129.3	280	226.5	164.6
41	33.2	24.1	101	81.7	59.4	161	130.3	94.6	221	178.8	129.9	281	227.3	165.2
42	34.0	24.7	102	82.5	60.0	162	131.1	95.2	222	179.6	130.5	282	228.1	165.8
43	34.8	25.3	103	83.3	60.5	163	131.9	95.8	223	180.4	131.1	283	229.0	166.3
44	35.6	25.9	104	84.1	61.1	164	132.7	96.4	224	181.2	131.7	284	229.8	166.9
45	36.4	26.5	105	84.9	61.7	165	133.5	97.0	225	182.0	132.3	285	230.6	167.5
46	37.2	27.0	106	85.8	62.3	166	134.3	97.6	226	182.8	132.8	286	231.4	168.1
47	38.0	27.6	107	86.6	62.9	167	135.1	98.2	227	183.6	133.4	287	232.2	168.7
48	38.8	28.2	108	87.4	63.5	168	135.9	98.7	228	184.5	134.0	288	233.0	169.3
49	39.6	28.8	109	88.2	64.1	169	136.7	99.3	229	185.3	134.6	289	233.8	169.9
50	40.5	29.4	110	89.0	64.7	170	137.5	99.9	230	186.1	135.2	290	234.6	170.5
51	41.3	30.0	111	89.8	65.2	171	138.3	100.5	231	186.9	135.8	291	235.4	171.0
52	42.1	30.6	112	90.6	65.8	172	139.2	101.1	232	187.7	136.4	292	236.2	171.6
53	42.9	31.2	113	91.4	66.4	173	140.0	101.7	233	188.5	137.0	293	237.0	172.2
54	43.7	31.7	114	92.2	67.0	174	140.8	102.3	234	189.3	137.5	294	237.9	172.8
55	44.5	32.3	115	93.0	67.6	175	141.6	102.9	235	190.1	138.1	295	238.7	173.4
56	45.3	32.9	116	93.8	68.2	176	142.4	103.5	236	190.9	138.7	296	239.5	174.0
57	46.1	33.5	117	94.7	68.8	177	143.2	104.0	237	191.7	139.3	297	240.3	174.6
58	46.9	34.1	118	95.5	69.4	178	144.0	104.6	238	192.5	139.9	298	241.1	175.2
59	47.7	34.7	119	96.3	69.9	179	144.8	105.2	239	193.4	140.5	299	241.9	175.7
60	48.5	35.3	120	97.1	70.5	180	145.6	105.8	240	194.2	141.1	300	242.7	176.3
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 54 Degrees.

TABLE II.

Difference of Latitude and Departure for 37 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	48.7	36.7	121	96.6	72.8	181	144.6	108.9	241	192.5	145.0
2	01.6	01.2	62	49.5	37.3	122	97.4	73.4	182	145.4	109.5	242	193.3	145.6
3	02.4	01.8	63	50.3	37.9	123	98.2	74.0	183	146.2	110.1	243	194.1	146.2
4	03.2	02.4	64	51.1	38.5	124	99.0	74.6	184	146.9	110.7	244	194.9	146.8
5	04.0	03.0	65	51.9	39.1	125	99.8	75.2	185	147.7	111.3	245	195.7	147.4
6	04.8	03.6	66	52.7	39.7	126	100.6	75.8	186	148.5	111.9	246	196.5	148.0
7	05.6	04.2	67	53.5	40.3	127	101.4	76.4	187	149.3	112.5	247	197.3	148.6
8	06.4	04.8	68	54.3	40.9	128	102.2	77.0	188	150.1	113.1	248	198.1	149.3
9	07.2	05.4	69	55.1	41.5	129	103.0	77.6	189	150.9	113.7	249	198.9	149.9
10	08.0	06.0	70	55.9	42.1	130	103.8	78.2	190	151.7	114.3	250	199.7	150.5
11	08.8	06.6	71	56.7	42.7	131	104.6	78.8	191	152.5	114.9	251	200.5	151.1
12	09.6	07.2	72	57.5	43.3	132	105.4	79.4	192	153.3	115.5	252	201.3	151.7
13	10.4	07.8	73	58.3	43.9	133	106.2	80.0	193	154.1	116.2	253	202.1	152.3
14	11.2	08.4	74	59.1	44.5	134	107.0	80.6	194	154.9	116.8	254	202.9	152.9
15	12.0	09.0	75	59.9	45.1	135	107.8	81.2	195	155.7	117.4	255	203.7	153.5
16	12.8	09.6	76	60.7	45.7	136	108.6	81.8	196	156.5	118.0	256	204.5	154.1
17	13.6	10.2	77	61.5	46.3	137	109.4	82.4	197	157.3	118.6	257	205.2	154.7
18	14.4	10.8	78	62.3	46.9	138	110.2	83.1	198	158.1	119.2	258	206.0	155.3
19	15.2	11.4	79	63.1	47.5	139	111.0	83.7	199	158.9	119.8	259	206.8	155.9
20	16.0	12.0	80	63.9	48.1	140	111.8	84.3	200	159.7	120.4	260	207.6	156.5
21	16.8	12.6	81	64.7	48.7	141	112.6	84.9	201	160.5	121.0	261	208.4	157.1
22	17.6	13.2	82	65.5	49.3	142	113.4	85.5	202	161.3	121.6	262	209.2	157.7
23	18.4	13.8	83	66.3	50.0	143	114.2	86.1	203	162.1	122.2	263	210.0	158.3
24	19.2	14.4	84	67.1	50.6	144	115.0	86.7	204	162.9	122.8	264	210.8	158.9
25	20.0	15.0	85	67.9	51.2	145	115.8	87.3	205	163.7	123.4	265	211.6	159.5
26	20.8	15.6	86	68.7	51.8	146	116.6	87.9	206	164.5	124.0	266	212.4	160.1
27	21.6	16.2	87	69.5	52.4	147	117.4	88.5	207	165.3	124.6	267	213.2	160.7
28	22.4	16.9	88	70.3	53.0	148	118.2	89.1	208	166.1	125.2	268	214.0	161.3
29	23.2	17.5	89	71.1	53.6	149	119.0	89.7	209	166.9	125.8	269	214.8	161.9
30	24.0	18.1	90	71.9	54.2	150	119.8	90.3	210	167.7	126.4	270	215.6	162.5
31	24.8	18.7	91	72.7	54.8	151	120.6	90.9	211	168.5	127.0	271	216.4	163.1
32	25.6	19.3	92	73.5	55.4	152	121.4	91.5	212	169.3	127.6	272	217.2	163.7
33	26.4	19.9	93	74.3	56.0	153	122.2	92.1	213	170.1	128.2	273	218.0	164.3
34	27.2	20.5	94	75.1	56.6	154	123.0	92.7	214	170.9	128.8	274	218.8	164.9
35	28.0	21.1	95	75.9	57.2	155	123.8	93.3	215	171.7	129.4	275	219.6	165.5
36	28.8	21.7	96	76.7	57.8	156	124.6	93.9	216	172.5	130.0	276	220.4	166.1
37	29.5	22.3	97	77.5	58.4	157	125.4	94.5	217	173.3	130.6	277	221.2	166.7
38	30.3	22.9	98	78.3	59.0	158	126.2	95.1	218	174.1	131.2	278	222.0	167.3
39	31.1	23.5	99	79.1	59.6	159	127.0	95.7	219	174.9	131.8	279	222.8	167.9
40	31.9	24.1	100	79.9	60.2	160	127.8	96.3	220	175.7	132.4	280	223.6	168.5
41	32.7	24.7	101	80.7	60.8	161	128.6	96.9	221	176.5	133.0	281	224.4	169.1
42	33.5	25.3	102	81.5	61.4	162	129.4	97.5	222	177.3	133.6	282	225.2	169.7
43	34.3	25.9	103	82.3	62.0	163	130.2	98.1	223	178.1	134.2	283	226.0	170.3
44	35.1	26.5	104	83.1	62.6	164	131.0	98.7	224	178.9	134.8	284	226.8	170.9
45	35.9	27.1	105	83.9	63.2	165	131.8	99.3	225	179.7	135.4	285	227.6	171.5
46	36.7	27.7	106	84.7	63.8	166	132.6	99.9	226	180.5	136.0	286	228.4	172.1
47	37.5	28.3	107	85.5	64.4	167	133.4	100.5	227	181.3	136.6	287	229.2	172.7
48	38.3	28.9	108	86.3	65.0	168	134.2	101.1	228	182.1	137.2	288	230.0	173.3
49	39.1	29.5	109	87.1	65.6	169	135.0	101.7	229	182.9	137.8	289	230.8	173.9
50	39.9	30.1	110	87.8	66.2	170	135.8	102.3	230	183.7	138.4	290	231.6	174.5
51	40.7	30.7	111	88.6	66.8	171	136.6	102.9	231	184.5	139.0	291	232.4	175.1
52	41.5	31.3	112	89.4	67.4	172	137.4	103.5	232	185.3	139.6	292	233.2	175.7
53	42.3	31.9	113	90.2	68.0	173	138.2	104.1	233	186.1	140.2	293	234.0	176.3
54	43.1	32.5	114	91.0	68.6	174	139.0	104.7	234	186.9	140.8	294	234.8	176.9
55	43.9	33.1	115	91.8	69.2	175	139.8	105.3	235	187.7	141.4	295	235.6	177.5
56	44.7	33.7	116	92.6	69.8	176	140.6	105.9	236	188.5	142.0	296	236.4	178.1
57	45.5	34.3	117	93.4	70.4	177	141.4	106.5	237	189.3	142.6	297	237.2	178.7
58	46.3	34.9	118	94.2	71.0	178	142.2	107.1	238	190.1	143.2	298	238.0	179.3
59	47.1	35.5	119	95.0	71.6	179	143.0	107.7	239	190.9	143.8	299	238.8	179.9
60	47.9	36.1	120	95.8	72.2	180	143.8	108.3	240	191.7	144.4	300	239.6	180.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 53 Degrees.

TABLE II.

Difference ot Latitude and Departure for 38 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	48.1	37.6	121	95.3	74.5	181	142.6	111.4	241	189.9	148.4
2	01.6	01.2	62	48.9	38.2	122	96.1	75.1	182	143.4	112.1	242	190.7	149.0
3	02.4	01.8	63	49.6	38.8	123	96.9	75.7	183	144.2	112.7	243	191.5	149.6
4	03.2	02.5	64	50.4	39.4	124	97.7	76.3	184	145.0	113.3	244	192.3	150.2
5	03.9	03.1	65	51.2	40.0	125	98.5	77.0	185	145.8	113.9	245	193.1	150.8
6	04.7	03.7	66	52.0	40.6	126	99.3	77.6	186	146.6	114.5	246	193.9	151.5
7	05.5	04.3	67	52.8	41.2	127	100.1	78.2	187	147.4	115.1	247	194.6	152.1
8	06.3	04.9	68	53.6	41.9	128	100.9	78.8	188	148.1	115.7	248	195.4	152.7
9	07.1	05.5	69	54.4	42.5	129	101.7	79.4	189	148.9	116.4	249	196.2	153.3
10	07.9	06.2	70	55.2	43.1	130	102.4	80.0	190	149.7	117.0	250	197.0	153.9
11	08.7	06.8	71	55.9	43.7	131	103.2	80.7	191	150.5	117.6	251	197.8	154.5
12	09.5	07.4	72	56.7	44.3	132	104.0	81.3	192	151.3	118.2	252	198.6	155.1
13	10.2	08.0	73	57.5	44.9	133	104.8	81.9	193	152.1	118.8	253	199.4	155.8
14	11.0	08.6	74	58.3	45.6	134	105.6	82.5	194	152.9	119.4	254	200.2	156.4
15	11.8	09.2	75	59.1	46.2	135	106.4	83.1	195	153.7	120.1	255	200.9	157.0
16	12.6	09.9	76	59.9	46.8	136	107.2	83.7	196	154.5	120.7	256	201.7	157.6
17	13.4	10.5	77	60.7	47.4	137	108.0	84.3	197	155.2	121.3	257	202.5	158.2
18	14.2	11.1	78	61.5	48.0	138	108.7	85.0	198	156.0	121.9	258	203.3	158.8
19	15.0	11.7	79	62.3	48.6	139	109.5	85.6	199	156.8	122.5	259	204.1	159.5
20	15.8	12.3	80	63.0	49.3	140	110.3	86.2	200	157.6	123.1	260	204.9	160.1
21	16.5	12.9	81	63.8	49.9	141	111.1	86.8	201	158.4	123.7	261	205.7	160.7
22	17.3	13.5	82	64.6	50.5	142	111.9	87.4	202	159.2	124.4	262	206.5	161.3
23	18.1	14.2	83	65.4	51.1	143	112.7	88.0	203	160.0	125.0	263	207.2	161.9
24	18.9	14.8	84	66.2	51.7	144	113.5	88.7	204	160.8	125.6	264	208.0	162.5
25	19.7	15.4	85	67.0	52.3	145	114.3	89.3	205	161.5	126.2	265	208.8	163.2
26	20.5	16.0	86	67.8	52.9	146	115.0	89.9	206	162.3	126.8	266	209.6	163.8
27	21.3	16.6	87	68.6	53.6	147	115.8	90.5	207	163.1	127.4	267	210.4	164.4
28	22.1	17.2	88	69.3	54.2	148	116.6	91.1	208	163.9	128.1	268	211.2	165.0
29	22.9	17.9	89	70.1	54.8	149	117.4	91.7	209	164.7	128.7	269	212.0	165.6
30	23.6	18.5	90	70.9	55.4	150	118.2	92.3	210	165.5	129.3	270	212.8	166.2
31	24.4	19.1	91	71.7	56.0	151	119.0	93.0	211	166.3	129.9	271	213.6	166.8
32	25.2	19.7	92	72.5	56.6	152	119.8	93.6	212	167.1	130.5	272	214.3	167.5
33	26.0	20.3	93	73.3	57.3	153	120.6	94.2	213	167.8	131.1	273	215.1	168.1
34	26.8	20.9	94	74.1	57.9	154	121.4	94.8	214	168.6	131.8	274	215.9	168.7
35	27.6	21.5	95	74.9	58.5	155	122.1	95.4	215	169.4	132.4	275	216.7	169.3
36	28.4	22.2	96	75.6	59.1	156	122.9	96.0	216	170.2	133.0	276	217.5	169.9
37	29.2	22.8	97	76.4	59.7	157	123.7	96.7	217	171.0	133.6	277	218.3	170.5
38	29.9	23.4	98	77.2	60.3	158	124.5	97.3	218	171.8	134.2	278	219.1	171.2
39	30.7	24.0	99	78.0	61.0	159	125.3	97.9	219	172.6	134.8	279	219.9	171.8
40	31.5	24.6	100	78.8	61.6	160	126.1	98.5	220	173.4	135.4	280	220.6	172.4
41	32.3	25.2	101	79.6	62.2	161	126.9	99.1	221	174.2	136.1	281	221.4	173.0
42	33.1	25.9	102	80.4	62.8	162	127.7	99.7	222	174.9	136.7	282	222.2	173.6
43	33.9	26.5	103	81.2	63.4	163	128.4	100.4	223	175.7	137.3	283	223.0	174.2
44	34.7	27.1	104	82.0	64.0	164	129.2	101.0	224	176.5	137.9	284	223.8	174.8
45	35.5	27.7	105	82.7	64.6	165	130.0	101.6	225	177.3	138.5	285	224.6	175.5
46	36.2	28.3	106	83.5	65.3	166	130.8	102.2	226	178.1	139.1	286	225.4	176.1
47	37.0	28.9	107	84.3	65.9	167	131.6	102.8	227	178.9	139.8	287	226.2	176.7
48	37.8	29.6	108	85.1	66.5	168	132.4	103.4	228	179.7	140.4	288	226.9	177.3
49	38.6	30.2	109	85.9	67.1	169	133.2	104.0	229	180.5	141.0	289	227.7	177.9
50	39.4	30.8	110	86.7	67.7	170	134.0	104.7	230	181.2	141.6	290	228.5	178.5
51	40.2	31.4	111	87.5	68.3	171	134.7	105.3	231	182.0	142.2	291	229.3	179.2
52	41.0	32.0	112	88.3	69.0	172	135.5	105.9	232	182.8	142.8	292	230.1	179.8
53	41.8	32.6	113	89.0	69.6	173	136.3	106.5	233	183.6	143.4	293	230.9	180.4
54	42.6	33.2	114	89.8	70.2	174	137.1	107.1	234	184.4	144.1	294	231.7	181.0
55	43.3	33.9	115	90.6	70.8	175	137.9	107.7	235	185.2	144.7	295	232.5	181.6
56	44.1	34.5	116	91.4	71.4	176	138.7	108.4	236	186.0	145.3	296	233.3	182.2
57	44.9	35.1	117	92.2	72.0	177	139.5	109.0	237	186.8	145.9	297	234.0	182.9
58	45.7	35.7	118	93.0	72.6	178	140.3	109.6	238	187.5	146.5	298	234.8	183.5
59	46.5	36.3	119	93.8	73.3	179	141.1	110.2	239	188.3	147.1	299	235.6	184.1
60	47.3	36.9	120	94.6	73.9	180	141.8	110.8	240	189.1	147.8	300	236.4	184.7
Dist	Dep.	Lat	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 52 Degrees.

TABLE II.

Difference of Latitude and Departure for 39 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	47.4	38.4	121	94.0	76.1	181	140.7	113.9	241	187.3	151.7
2	01.6	01.3	62	48.2	39.0	122	94.8	76.8	182	141.4	114.5	242	188.1	152.3
3	02.3	01.9	63	49.0	39.6	123	95.6	77.4	183	142.2	115.2	243	188.8	152.9
4	03.1	02.5	64	49.7	40.3	124	96.4	78.0	184	143.0	115.8	244	189.6	153.6
5	03.9	03.1	65	50.5	40.9	125	97.1	78.7	185	143.8	116.4	245	190.4	154.2
6	04.7	03.8	66	51.3	41.5	126	97.9	79.3	186	144.5	117.1	246	191.2	154.8
7	05.4	04.4	67	52.1	42.2	127	98.7	79.9	187	145.3	117.7	247	192.0	155.4
8	06.2	05.0	68	52.8	42.8	128	99.5	80.6	188	146.1	118.3	248	192.7	156.1
9	07.0	05.7	69	53.6	43.4	129	100.3	81.2	189	146.9	118.9	249	193.5	156.7
10	07.8	06.3	70	54.4	44.1	130	101.0	81.8	190	147.7	119.6	250	194.3	157.3
11	08.5	06.9	71	55.2	44.7	131	101.8	82.4	191	148.4	120.2	251	195.1	158.0
12	09.3	07.6	72	56.0	45.3	132	102.6	83.1	192	149.2	120.8	252	195.8	158.6
13	10.1	08.2	73	56.7	45.9	133	103.4	83.7	193	150.0	121.5	253	196.6	159.2
14	10.9	08.8	74	57.5	46.6	134	104.1	84.3	194	150.8	122.1	254	197.4	159.8
15	11.7	09.4	75	58.3	47.2	135	104.9	85.0	195	151.5	122.7	255	198.2	160.5
16	12.4	10.1	76	59.1	47.8	136	105.7	85.6	196	152.3	123.3	256	198.9	161.1
17	13.2	10.7	77	59.8	48.5	137	106.5	86.2	197	153.1	124.0	257	199.7	161.7
18	14.0	11.3	78	60.6	49.1	138	107.2	86.8	198	153.9	124.6	258	200.5	162.4
19	14.8	12.0	79	61.4	49.7	139	108.0	87.5	199	154.7	125.2	259	201.3	163.0
20	15.5	12.6	80	62.2	50.3	140	108.8	88.1	200	155.4	125.9	260	202.1	163.6
21	16.3	13.2	81	62.9	51.0	141	109.6	88.7	201	156.2	126.5	261	202.8	164.3
22	17.1	13.8	82	63.7	51.6	142	110.4	89.4	202	157.0	127.1	262	203.6	164.9
23	17.9	14.5	83	64.5	52.2	143	111.1	90.0	203	157.8	127.8	263	204.4	165.5
24	18.7	15.1	84	65.3	52.9	144	111.9	90.6	204	158.5	128.4	264	205.2	166.1
25	19.4	15.7	85	66.1	53.5	145	112.7	91.3	205	159.3	129.0	265	205.9	166.8
26	20.2	16.4	86	66.8	54.1	146	113.5	91.9	206	160.1	129.6	266	206.7	167.4
27	21.0	17.0	87	67.6	54.8	147	114.2	92.5	207	160.9	130.3	267	207.5	168.0
28	21.8	17.6	88	68.4	55.4	148	115.0	93.1	208	161.6	130.9	268	208.3	168.7
29	22.5	18.3	89	69.2	56.0	149	115.8	93.8	209	162.4	131.5	269	209.1	169.3
30	23.3	18.9	90	69.9	56.6	150	116.6	94.4	210	163.2	132.2	270	209.8	169.9
31	24.1	19.5	91	70.7	57.3	151	117.3	95.0	211	164.0	132.8	271	210.6	170.5
32	24.9	20.1	92	71.5	57.9	152	118.1	95.7	212	164.8	133.4	272	211.4	171.2
33	25.6	20.8	93	72.3	58.5	153	118.9	96.3	213	165.5	134.0	273	212.2	171.8
34	26.4	21.4	94	73.1	59.2	154	119.7	96.9	214	166.3	134.7	274	212.9	172.4
35	27.2	22.0	95	73.8	59.8	155	120.5	97.5	215	167.1	135.3	275	213.7	173.1
36	28.0	22.7	96	74.6	60.4	156	121.2	98.2	216	167.9	135.9	276	214.5	173.7
37	28.8	23.3	97	75.4	61.0	157	122.0	98.8	217	168.6	136.6	277	215.3	174.3
38	29.5	23.9	98	76.2	61.7	158	122.8	99.4	218	169.4	137.2	278	216.0	175.0
39	30.3	24.5	99	76.9	62.3	159	123.6	100.1	219	170.2	137.8	279	216.8	175.6
40	31.1	25.2	100	77.7	62.9	160	124.3	100.7	220	171.0	138.5	280	217.6	176.2
41	31.9	25.8	101	78.5	63.6	161	125.1	101.3	221	171.7	139.1	281	218.4	176.8
42	32.6	26.4	102	79.3	64.2	162	125.9	101.9	222	172.5	139.7	282	219.2	177.5
43	33.4	27.1	103	80.0	64.8	163	126.7	102.6	223	173.3	140.3	283	219.9	178.1
44	34.2	27.7	104	80.8	65.4	164	127.5	103.2	224	174.1	141.0	284	220.7	178.7
45	35.0	28.3	105	81.6	66.1	165	128.2	103.8	225	174.9	141.6	285	221.5	179.4
46	35.7	28.9	106	82.4	66.7	166	129.0	104.5	226	175.6	142.2	286	222.3	180.0
47	36.5	29.6	107	83.2	67.3	167	129.8	105.1	227	176.4	142.9	287	223.0	180.6
48	37.3	30.2	108	83.9	68.0	168	130.6	105.7	228	177.2	143.5	288	223.8	181.2
49	38.1	30.8	109	84.7	68.6	169	131.3	106.4	229	178.0	144.1	289	224.6	181.9
50	38.9	31.5	110	85.5	69.2	170	132.1	107.0	230	178.7	144.7	290	225.4	182.5
51	39.6	32.1	111	86.3	69.9	171	132.9	107.6	231	179.5	145.4	291	226.1	183.1
52	40.4	32.7	112	87.0	70.5	172	133.7	108.2	232	180.3	146.0	292	226.9	183.8
53	41.2	33.4	113	87.8	71.1	173	134.4	108.9	233	181.1	146.6	293	227.7	184.4
54	42.0	34.0	114	88.6	71.7	174	135.2	109.5	234	181.9	147.3	294	228.5	185.0
55	42.7	34.6	115	89.4	72.4	175	136.0	110.1	235	182.6	147.9	295	229.3	185.6
56	43.5	35.2	116	90.1	73.0	176	136.8	110.8	236	183.4	148.5	296	230.0	186.3
57	44.3	35.9	117	90.9	73.6	177	137.6	111.4	237	184.2	149.1	297	230.8	186.9
58	45.1	36.5	118	91.7	74.3	178	138.3	112.0	238	185.0	149.8	298	231.6	187.5
59	45.9	37.1	119	92.5	74.9	179	139.1	112.6	239	185.7	150.4	299	232.4	188.2
60	46.6	37.8	120	93.3	75.5	180	139.9	113.3	240	186.5	151.0	300	233.1	188.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 51 Degrees.

TABLE II.

Difference of Latitude and Departure for 40 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	46.7	39.2	121	92.7	77.8	181	138.7	116.3	241	184.6	154.9
2	01.5	01.3	62	47.5	39.9	122	93.5	78.4	182	139.4	117.0	242	185.4	155.6
3	02.3	01.9	63	48.3	40.5	123	94.2	79.1	183	140.2	117.6	243	186.1	156.2
4	03.1	02.6	64	49.0	41.1	124	95.0	79.7	184	141.0	118.3	244	186.9	156.8
5	03.8	03.2	65	49.8	41.8	125	95.8	80.3	185	141.7	118.9	245	187.7	157.5
6	04.6	03.9	66	50.6	42.4	126	96.5	81.0	186	142.5	119.6	246	188.4	158.1
7	05.4	04.5	67	51.3	43.1	127	97.3	81.6	187	143.3	120.2	247	189.2	158.8
8	06.1	05.1	68	52.1	43.7	128	98.1	82.3	188	144.0	120.8	248	190.0	159.4
9	06.9	05.8	69	52.9	44.4	129	98.8	82.9	189	144.8	121.5	249	190.7	160.1
10	07.7	06.4	70	53.6	45.0	130	99.6	83.6	190	145.5	122.1	250	191.5	160.7
11	08.4	07.1	71	54.4	45.6	131	100.4	84.2	191	146.3	122.8	251	192.3	161.3
12	09.2	07.7	72	55.2	46.3	132	101.1	84.8	192	147.1	123.4	252	193.0	162.0
13	10.0	08.4	73	55.9	46.9	133	101.9	85.5	193	147.8	124.1	253	193.8	162.6
14	10.7	09.0	74	56.7	47.6	134	102.6	86.1	194	148.6	124.7	254	194.6	163.3
15	11.5	09.6	75	57.5	48.2	135	103.4	86.8	195	149.4	125.3	255	195.3	163.9
16	12.3	10.3	76	58.2	48.9	136	104.2	87.4	196	150.1	126.0	256	196.1	164.6
17	13.0	10.9	77	59.0	49.5	137	104.9	88.1	197	150.9	126.6	257	196.9	165.2
18	13.8	11.6	78	59.8	50.1	138	105.7	88.7	198	151.7	127.3	258	197.6	165.8
19	14.6	12.2	79	60.5	50.8	139	106.5	89.3	199	152.4	127.9	259	198.4	166.5
20	15.3	12.9	80	61.3	51.4	140	107.2	90.0	200	153.2	128.6	260	199.2	167.1
21	16.1	13.5	81	62.0	52.1	141	108.0	90.6	201	154.0	129.2	261	199.9	167.8
22	16.9	14.1	82	62.8	52.7	142	108.8	91.3	202	154.7	129.8	262	200.7	168.4
23	17.6	14.8	83	63.6	53.4	143	109.5	91.9	203	155.5	130.5	263	201.5	169.1
24	18.4	15.4	84	64.3	54.0	144	110.3	92.6	204	156.3	131.1	264	202.2	169.7
25	19.2	16.1	85	65.1	54.6	145	111.1	93.2	205	157.0	131.8	265	203.0	170.3
26	19.9	16.7	86	65.9	55.3	146	111.8	93.8	206	157.8	132.4	266	203.8	171.0
27	20.7	17.4	87	66.6	55.9	147	112.6	94.5	207	158.6	133.1	267	204.5	171.6
28	21.4	18.0	88	67.4	56.6	148	113.4	95.1	208	159.3	133.7	268	205.3	172.3
29	22.2	18.6	89	68.2	57.2	149	114.1	95.8	209	160.1	134.3	269	206.1	172.9
30	23.0	19.3	90	68.9	57.9	150	114.9	96.4	210	160.9	135.0	270	206.8	173.6
31	23.7	19.9	91	69.7	58.5	151	115.7	97.1	211	161.6	135.6	271	207.6	174.2
32	24.5	20.6	92	70.5	59.1	152	116.4	97.7	212	162.4	136.3	272	208.4	174.8
33	25.3	21.2	93	71.2	59.8	153	117.2	98.3	213	163.2	136.9	273	209.1	175.5
34	26.0	21.9	94	72.0	60.4	154	118.0	99.0	214	163.9	137.6	274	209.9	176.1
35	26.8	22.5	95	72.8	61.1	155	118.7	99.6	215	164.7	138.2	275	210.7	176.8
36	27.6	23.1	96	73.5	61.7	156	119.5	100.3	216	165.5	138.8	276	211.4	177.4
37	28.3	23.8	97	74.3	62.4	157	120.3	100.9	217	166.2	139.5	277	212.2	178.1
38	29.1	24.4	98	75.1	63.0	158	121.0	101.6	218	167.0	140.1	278	213.0	178.7
39	29.9	25.1	99	75.8	63.6	159	121.8	102.2	219	167.8	140.8	279	213.7	179.3
40	30.6	25.7	100	76.6	64.3	160	122.6	102.8	220	168.5	141.4	280	214.5	180.0
41	31.4	26.4	101	77.4	64.9	161	123.3	103.5	221	169.3	142.1	281	215.3	180.6
42	32.2	27.0	102	78.1	65.6	162	124.1	104.1	222	170.1	142.7	282	216.0	181.3
43	32.9	27.6	103	78.9	66.2	163	124.9	104.8	223	170.8	143.3	283	216.8	181.9
44	33.7	28.3	104	79.7	66.8	164	125.6	105.4	224	171.6	144.0	284	217.6	182.6
45	34.5	28.9	105	80.4	67.5	165	126.4	106.1	225	172.4	144.6	285	218.3	183.2
46	35.2	29.6	106	81.2	68.1	166	127.2	106.7	226	173.1	145.3	286	219.1	183.8
47	36.0	30.2	107	82.0	68.8	167	127.9	107.3	227	173.9	145.9	287	219.9	184.5
48	36.8	30.9	108	82.7	69.4	168	128.7	108.0	228	174.7	146.6	288	220.6	185.1
49	37.5	31.5	109	83.5	70.1	169	129.5	108.6	229	175.4	147.2	289	221.4	185.8
50	38.3	32.1	110	84.3	70.7	170	130.2	109.3	230	176.2	147.8	290	222.2	186.4
51	39.1	32.8	111	85.0	71.3	171	131.0	109.9	231	177.0	148.5	291	222.9	187.1
52	39.8	33.4	112	85.8	72.0	172	131.8	110.6	232	177.7	149.1	292	223.7	187.7
53	40.6	34.1	113	86.6	72.6	173	132.5	111.2	233	178.5	149.8	293	224.5	188.3
54	41.4	34.7	114	87.3	73.3	174	133.3	111.8	234	179.3	150.4	294	225.2	189.0
55	42.1	35.4	115	88.1	73.9	175	134.1	112.5	235	180.0	151.1	295	226.0	189.6
56	42.9	36.0	116	88.9	74.6	176	134.8	113.1	236	180.8	151.7	296	226.7	190.3
57	43.7	36.6	117	89.6	75.2	177	135.6	113.8	237	181.6	152.3	297	227.5	190.9
58	44.4	37.3	118	90.4	75.8	178	136.4	114.4	238	182.3	153.0	298	228.3	191.6
59	45.2	37.9	119	91.2	76.5	179	137.1	115.1	239	183.1	153.6	299	229.0	192.2
60	46.0	38.6	120	91.9	77.1	180	137.9	115.7	240	183.9	154.3	300	229.8	192.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 50 Degrees.

TABLE II.

Difference of Latitude and Departure for 41 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.7	61	46.0	40.0	121	91.3	79.4	181	136.6	118.7	241	181.9	158.1
2	01.5	01.3	62	46.8	40.7	122	92.1	80.0	182	137.4	119.4	242	182.6	158.8
3	02.3	02.0	63	47.5	41.3	123	92.8	80.7	183	138.1	120.1	243	183.4	159.4
4	03.0	02.6	64	48.3	42.0	124	93.6	81.4	184	138.9	120.7	244	184.1	160.1
5	03.8	03.3	65	49.1	42.6	125	94.3	82.0	185	139.6	121.4	245	184.9	160.7
6	04.5	03.9	66	49.8	43.3	126	95.1	82.7	186	140.4	122.0	246	185.7	161.4
7	05.3	04.6	67	50.6	44.0	127	95.8	83.3	187	141.1	122.7	247	186.4	162.0
8	06.0	05.2	68	51.3	44.6	128	96.6	84.0	188	141.9	123.3	248	187.2	162.7
9	06.8	05.9	69	52.1	45.3	129	97.4	84.6	189	142.6	124.0	249	187.9	163.4
10	07.5	06.6	70	52.8	45.9	130	98.1	85.3	190	143.4	124.7	250	188.7	164.0
11	08.3	07.2	71	53.6	46.6	131	98.9	85.9	191	144.1	125.3	251	189.4	164.7
12	09.1	07.9	72	54.3	47.2	132	99.6	86.6	192	144.9	126.0	252	190.2	165.3
13	09.8	08.5	73	55.1	47.9	133	100.4	87.3	193	145.7	126.6	253	190.9	166.0
14	10.6	09.2	74	55.8	48.5	134	101.1	87.9	194	146.4	127.3	254	191.7	166.6
15	11.3	09.8	75	56.6	49.2	135	101.9	88.6	195	147.2	127.9	255	192.5	167.3
16	12.1	10.5	76	57.4	49.9	136	102.6	89.2	196	147.9	128.6	256	193.2	168.0
17	12.8	11.2	77	58.1	50.5	137	103.4	89.9	197	148.7	129.2	257	194.0	168.6
18	13.6	11.8	78	58.9	51.2	138	104.1	90.5	198	149.4	129.9	258	194.7	169.3
19	14.3	12.5	79	59.6	51.8	139	104.9	91.2	199	150.2	130.6	259	195.5	169.9
20	15.1	13.1	80	60.4	52.5	140	105.7	91.8	200	150.9	131.2	260	196.2	170.6
21	15.8	13.8	81	61.1	53.1	141	106.4	92.5	201	151.7	131.9	261	197.0	171.2
22	16.6	14.4	82	61.9	53.8	142	107.2	93.2	202	152.5	132.5	262	197.7	171.9
23	17.4	15.1	83	62.6	54.5	143	107.9	93.8	203	153.2	133.2	263	198.5	172.5
24	18.1	15.7	84	63.4	55.1	144	108.7	94.5	204	154.0	133.8	264	199.2	173.2
25	18.9	16.4	85	64.2	55.8	145	109.4	95.1	205	154.7	134.5	265	200.0	173.9
26	19.6	17.1	86	64.9	56.4	146	110.2	95.8	206	155.5	135.1	266	200.8	174.5
27	20.4	17.7	87	65.7	57.1	147	110.9	96.4	207	156.2	135.8	267	201.5	175.2
28	21.1	18.4	88	66.4	57.7	148	111.7	97.1	208	157.0	136.5	268	202.3	175.8
29	21.9	19.0	89	67.2	58.4	149	112.5	97.8	209	157.7	137.1	269	203.0	176.5
30	22.6	19.7	90	67.9	59.0	150	113.2	98.4	210	158.5	137.8	270	203.8	177.1
31	23.4	20.3	91	68.7	59.7	151	114.0	99.1	211	159.2	138.4	271	204.5	177.8
32	24.2	21.0	92	69.4	60.4	152	114.7	99.7	212	160.0	139.1	272	205.3	178.4
33	24.9	21.6	93	70.2	61.0	153	115.5	100.4	213	160.8	139.7	273	206.0	179.1
34	25.7	22.3	94	70.9	61.7	154	116.2	101.0	214	161.5	140.4	274	206.8	179.8
35	26.4	23.0	95	71.7	62.3	155	117.0	101.7	215	162.3	141.1	275	207.5	180.4
36	27.2	23.6	96	72.5	63.0	156	117.7	102.3	216	163.0	141.7	276	208.3	181.1
37	27.9	24.3	97	73.2	63.6	157	118.5	103.0	217	163.8	142.4	277	209.1	181.7
38	28.7	24.9	98	74.0	64.3	158	119.2	103.7	218	164.5	143.0	278	209.8	182.4
39	29.4	25.6	99	74.7	64.9	159	120.0	104.3	219	165.3	143.7	279	210.6	183.0
40	30.2	26.2	100	75.5	65.6	160	120.8	105.0	220	166.0	144.3	280	211.3	183.7
41	30.9	26.9	101	76.2	66.3	161	121.5	105.6	221	166.8	145.0	281	212.1	184.4
42	31.7	27.6	102	77.0	66.9	162	122.3	106.3	222	167.5	145.6	282	212.8	185.0
43	32.5	28.2	103	77.7	67.6	163	123.0	106.9	223	168.3	146.3	283	213.6	185.7
44	33.2	28.9	104	78.5	68.2	164	123.8	107.6	224	169.1	147.0	284	214.3	186.3
45	34.0	29.5	105	79.2	68.9	165	124.5	108.2	225	169.8	147.6	285	215.1	187.0
46	34.7	30.2	106	80.0	69.5	166	125.3	108.9	226	170.6	148.3	286	215.8	187.6
47	35.5	30.8	107	80.8	70.2	167	126.0	109.6	227	171.3	148.9	287	216.6	188.3
48	36.2	31.5	108	81.5	70.9	168	126.8	110.2	228	172.1	149.6	288	217.4	188.9
49	37.0	32.1	109	82.3	71.5	169	127.5	110.9	229	172.8	150.2	289	218.1	189.6
50	37.7	32.8	110	83.0	72.2	170	128.3	111.5	230	173.6	150.9	290	218.9	190.3
51	38.5	33.5	111	83.8	72.8	171	129.1	112.2	231	174.3	151.5	291	219.6	190.9
52	39.2	34.1	112	84.5	73.5	172	129.8	112.8	232	175.1	152.2	292	220.4	191.6
53	40.0	34.8	113	85.3	74.1	173	130.6	113.5	233	175.8	152.9	293	221.1	192.2
54	40.8	35.4	114	86.0	74.8	174	131.3	114.2	234	176.6	153.5	294	221.9	192.9
55	41.5	36.1	115	86.8	75.4	175	132.1	114.8	235	177.4	154.2	295	222.6	193.5
56	42.3	36.7	116	87.5	76.1	176	132.8	115.5	236	178.1	154.8	296	223.4	194.2
57	43.0	37.4	117	88.3	76.8	177	133.6	116.1	237	178.9	155.5	297	224.1	194.8
58	43.8	38.1	118	89.1	77.4	178	134.3	116.8	238	179.6	156.1	298	224.9	195.5
59	44.5	38.7	119	89.8	78.1	179	135.1	117.4	239	180.4	156.8	299	225.7	196.2
60	45.3	39.4	120	90.6	78.7	180	135.8	118.1	240	181.1	157.5	300	226.4	196.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 49 Degrees.

TABLE II.

Difference of Latitude and Departure for 42 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	45.3	40.8	121	89.9	81.0	181	134.5	121.1	241	179.1	161.3
2	01.5	01.3	62	46.1	41.5	122	90.7	81.6	182	135.3	121.8	242	179.8	161.9
3	02.2	02.0	63	46.8	42.2	123	91.4	82.3	183	136.0	122.5	243	180.6	162.6
4	03.0	02.7	64	47.6	42.8	124	92.1	83.0	184	136.7	123.1	244	181.3	163.3
5	03.7	03.3	65	48.3	43.5	125	92.9	83.6	185	137.5	123.8	245	182.1	163.9
6	04.5	04.0	66	49.0	44.2	126	93.6	84.3	186	138.2	124.5	246	182 8	164.6
7	05.2	04.7	67	49.8	44.8	127	94.4	85.0	187	139.0	125.1	247	183.6	165.3
8	05.9	05.4	68	50.5	45.5	128	95.1	85.6	188	139.7	125.8	248	184.3	165.9
9	06.7	06.0	69	51.3	46.2	129	95.9	86.3	189	140.5	126.5	249	185.0	166.6
10	07.4	06.7	70	52.0	46.8	130	96.6	87.0	190	141.2	127.1	250	185.8	167.3
11	08.2	07.4	71	52.8	47.5	131	97.4	87.7	191	141.9	127.8	251	186.5	168.0
12	08.9	08.0	72	53.5	48.2	132	98.1	88.3	192	142.7	128.5	252	187.3	168.6
13	09.7	08.7	73	54.2	48.8	133	98.8	89.0	193	143.4	129.1	253	188.0	169.3
14	10.4	09.4	74	55.0	49.5	134	99.6	89.7	194	144.2	129.8	254	188.8	170.0
15	11.1	10.0	75	55.7	50.2	135	100.3	90.3	195	144.9	130.5	255	189.5	170.6
16	11.9	10.7	76	56.5	50.9	136	101.1	91.0	196	145.7	131.1	256	190.2	171.3
17	12.6	11.4	77	57.2	51.5	137	101.8	91.7	197	146.4	131.8	257	191.0	172.0
18	13.4	12.0	78	58.0	52.2	138	102.6	92.3	198	147.1	132.5	258	191.7	172.6
19	14.1	12.7	79	58.7	52.9	139	103.3	93.0	199	147.9	133.2	259	192.5	173.3
20	14.9	13.4	80	59.5	53.5	140	104.0	93.7	200	148.6	133.8	260	193.2	174.0
21	15.6	14.1	81	60.2	54.2	141	104.8	94.3	201	149.4	134.5	261	194.0	174.6
22	16.3	14.7	82	60.9	54.9	142	105.5	95.0	202	150.1	135.2	262	194.7	175.3
23	17.1	15.4	83	61.7	55.5	143	106.3	95.7	203	150.9	135.8	263	195.4	176.0
24	17.8	16.1	84	62.4	56.2	144	107.0	96.4	204	151.6	136.5	264	196.2	176.7
25	18.6	16.7	85	63.2	56.9	145	107.8	97.0	205	152.3	137.2	265	196.9	177.3
26	19.3	17.4	86	63.9	57.5	146	108.5	97.7	206	153.1	137.8	266	197.7	178.0
27	20.1	18.1	87	64.7	58.2	147	109.2	98.4	207	153.8	138.5	267	198.4	178.7
28	20.8	18.7	88	65.4	58.9	148	110.0	99.0	208	154.6	139.2	268	199.2	179.3
29	21.6	19.4	89	66.1	59.6	149	110.7	99.7	209	155.3	139.8	269	199.9	180.0
30	22.3	20.1	90	66.9	60.2	150	111.5	100.4	210	156.1	140.5	270	200.6	180.7
31	23.0	20.7	91	67.6	60.9	151	112.2	101.0	211	156.8	141.2	271	201.4	181.3
32	23.8	21.4	92	68.4	61.6	152	113.0	101.7	212	157.5	141.9	272	202.1	182.0
33	24.5	22.1	93	69.1	62.2	153	113.7	102.4	213	158.3	142.5	273	202.9	182.7
34	25.3	22.8	94	69.9	62.9	154	114.4	103.0	214	159.0	143.2	274	203.6	183.3
35	26.0	23.4	95	70.6	63.6	155	115.2	103.7	215	159.8	143.9	275	204.4	184.0
36	26.8	24.1	96	71.3	64.2	156	115.9	104.4	216	160.5	144.5	276	205.1	184.7
37	27.5	24.8	97	72.1	64.9	157	116.7	105.1	217	161.3	145.2	277	205.9	185.3
38	28.2	25.4	98	72.8	65.6	158	117.4	105.7	218	162.0	145.9	278	206.6	186.0
39	29.0	26.1	99	73.6	66.2	159	118.2	106.4	219	162.7	146.5	279	207.3	186.7
40	29.7	26.8	100	74.3	66.9	160	118.9	107.1	220	163.5	147.2	280	208.1	187.4
41	30.5	27.4	101	75.1	67.6	161	119.6	107.7	221	164.2	147.9	281	208.8	188.0
42	31.2	28.1	102	75.8	68.3	162	120.4	108.4	222	165.0	148.5	282	209.6	188.7
43	32.0	28.8	103	76.5	68.9	163	121.1	109.1	223	165.7	149.2	283	210.3	189.4
44	32.7	29.4	104	77.3	69.6	164	121.9	109.7	224	166.5	149.9	284	211.1	190.0
45	33.4	30.1	105	78.0	70.3	165	122.6	110.4	225	167.2	150.6	285	211.8	190.7
46	34.2	30.8	106	78.8	70.9	166	123.4	111.1	226	168.0	151.2	286	212.5	191.4
47	34.9	31.4	107	79.5	71.6	167	124.1	111.7	227	168.7	151.9	287	213.3	192.0
48	35.7	32.1	108	80.3	72.3	168	124.8	112.4	228	169.4	152.6	288	214.0	192.7
49	36.4	32.8	109	81.0	72.9	169	125.6	113.1	229	170.2	153.2	289	214.8	193.4
50	37.2	33.5	110	81.7	73.6	170	126.3	113.8	230	170.9	153.9	290	215.5	194.0
51	37.9	34.1	111	82.5	74.3	171	127.1	114.4	231	171.7	154.6	291	216.3	194.7
52	38.6	34.8	112	83.2	74.9	172	127.8	115.1	232	172.4	155.2	292	217.0	195.4
53	39.4	35.5	113	84.0	75.6	173	128.6	115.8	233	173.2	155.9	293	217.7	196.1
54	40.1	36.1	114	84.7	76.3	174	129.3	116.4	234	173.9	156.6	294	218.5	196.7
55	40.9	36.8	115	85.5	77.0	175	130.1	117.1	235	174.6	157.2	295	219.2	197.4
56	41.6	37.5	116	86.2	77.6	176	130.8	117.8	236	175.4	157.9	296	220.0	198.1
57	42.4	38.1	117	86.9	78.3	177	131.5	118.4	237	176.1	158.6	297	220.7	198.7
58	43.1	38.8	118	87.7	79.0	178	132.3	119.1	238	176.9	159.3	298	221.5	199.4
59	43.8	39.5	119	88.4	79.6	179	133.0	119.8	239	177.6	159.9	299	222.2	200.1
60	44.6	40.1	120	89.2	80.3	180	133.8	120.4	240	178.4	160.6	300	222.9	200.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep	Lat.

for 48 Degrees.

TABLE II.

Difference of Latitude and Departure for 43 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	44.6	41.6	121	88.5	82.5	181	132.4	123.4	241	176.3	164.4
2	01.5	01.4	62	45.3	42.3	122	89.2	83.2	182	133.1	124.1	242	177.0	165.0
3	02.2	02.0	63	46.1	43.0	123	90.0	83.9	183	133.8	124.8	243	177.7	165.7
4	02.9	02.7	64	46.8	43.6	124	90.7	84.6	184	134.6	125.5	244	178.5	166.4
5	03.7	03.4	65	47.5	44.3	125	91.4	85.2	185	135.3	126.2	245	179.2	167.1
6	04.4	04.1	66	48.3	45.0	126	92.2	85.9	186	136.0	126.9	246	179.9	167.8
7	05.1	04.8	67	49.0	45.7	127	92.9	86.6	187	136.8	127.5	247	180.6	168.5
8	05.9	05.5	68	49.7	46.4	128	93.6	87.3	188	137.5	128.2	248	181.4	169.1
9	06.6	06.1	69	50.5	47.1	129	94.3	88.0	189	138.2	128.9	249	182.1	169.8
10	07.3	06.8	70	51.2	47.7	130	95.1	88.7	190	139.0	129.6	250	182.8	170.5
11	08.0	07.5	71	51.9	48.4	131	95.8	89.3	191	139.7	130.3	251	183.6	171.2
12	08.8	08.2	72	52.7	49.1	132	96.5	90.0	192	140.4	130.9	252	184.3	171.9
13	09.5	08.9	73	53.4	49.8	133	97.3	90.7	193	141.2	131.6	253	185.0	172.5
14	10.2	09.5	74	54.1	50.5	134	98.0	91.4	194	141.9	132.3	254	185.8	173.2
15	11.0	10.2	75	54.9	51.1	135	98.7	92.1	195	142.6	133.0	255	186.5	173.9
16	11.7	10.9	76	55.6	51.8	136	99.5	92.8	196	143.3	133.7	256	187.2	174.6
17	12.4	11.6	77	56.3	52.5	137	100.2	93.4	197	144.1	134.4	257	188.0	175.3
18	13.2	12.3	78	57.0	53.2	138	100.9	94.1	198	144.8	135.0	258	188.7	176.0
19	13.9	13.0	79	57.8	53.9	139	101.7	94.8	199	145.5	135.7	259	189.4	176.6
20	14.6	13.6	80	58.5	54.6	140	102.4	95.5	200	146.3	136.4	260	190.2	177.3
21	15.4	14.3	81	59.2	55.2	141	103.1	96.2	201	147.0	137.1	261	190.9	178.0
22	16.1	15.0	82	60.0	55.9	142	103.9	96.8	202	147.7	137.8	262	191.6	178.7
23	16.8	15.7	83	60.7	56.6	143	104.6	97.5	203	148.5	138.4	263	192.3	179.4
24	17.6	16.4	84	61.4	57.3	144	105.3	98.2	204	149.2	139.1	264	193.1	180.0
25	18.3	17.0	85	62.2	58.0	145	106.0	98.9	205	149.9	139.8	265	193.8	180.7
26	19.0	17.7	86	62.9	58.7	146	106.8	99.6	206	150.7	140.5	266	194.5	181.4
27	19.7	18.4	87	63.6	59.3	147	107.5	100.3	207	151.4	141.2	267	195.3	182.1
28	20.5	19.1	88	64.4	60.0	148	108.2	100.9	208	152.1	141.9	268	196.0	182.8
29	21.2	19.8	89	65.1	60.7	149	109.0	101.6	209	152.9	142.5	269	196.7	183.5
30	21.9	20.5	90	65.8	61.4	150	109.7	102.3	210	153.6	143.2	270	197.5	184.1
31	22.7	21.1	91	66.6	62.1	151	110.4	103.0	211	154.3	143.9	271	198.2	184.8
32	23.4	21.8	92	67.3	62.7	152	111.2	103.7	212	155.0	144.6	272	198.9	185.5
33	24.1	22.5	93	68.0	63.4	153	111.9	104.3	213	155.8	145.3	273	199.7	186.2
34	24.9	23.2	94	68.7	64.1	154	112.6	105.0	214	156.5	145.9	274	200.4	186.9
35	25.6	23.9	95	69.5	64.8	155	113.4	105.7	215	157.2	146.6	275	201.1	187.5
36	26.3	24.6	96	70.2	65.5	156	114.1	106.4	216	158.0	147.3	276	201.9	188.2
37	27.1	25.2	97	70.9	66.2	157	114.8	107.1	217	158.7	148.0	277	202.6	188.9
38	27.8	25.9	98	71.7	66.8	158	115.6	107.8	218	159.4	148.7	278	203.3	189.6
39	28.5	26.6	99	72.4	67.5	159	116.3	108.4	219	160.2	149.4	279	204.0	190.3
40	29.3	27.3	100	73.1	68.2	160	117.0	109.1	220	160.9	150.0	280	204.8	191.0
41	30.0	28.0	101	73.9	68.9	161	117.7	109.8	221	161.6	150.7	281	205.5	191.6
42	30.7	28.6	102	74.6	69.6	162	118.5	110.5	222	162.4	151.4	282	206.2	192.3
43	31.4	29.3	103	75.3	70.2	163	119.2	111.2	223	163.1	152.1	283	207.0	193.0
44	32.2	30.0	104	76.1	70.9	164	119.9	111.8	224	163.8	152.8	284	207.7	193.7
45	32.9	30.7	105	76.8	71.6	165	120.7	112.5	225	164.6	153.4	285	208.4	194.4
46	33.6	31.4	106	77.5	72.3	166	121.4	113.2	226	165.3	154.1	286	209.2	195.1
47	34.4	32.1	107	78.3	73.0	167	122.1	113.9	227	166.0	154.8	287	209.9	195.7
48	35.1	32.7	108	79.0	73.7	168	122.9	114.6	228	166.7	155.5	288	210.6	196.4
49	35.8	33.4	109	79.7	74.3	169	123.6	115.3	229	167.5	156.2	289	211.4	197.1
50	36.6	34.1	110	80.4	75.0	170	124.3	115.9	230	168.2	156.9	290	212.1	197.8
51	37.3	34.8	111	81.2	75.7	171	125.1	116.6	231	168.9	157.5	291	212.8	198.5
52	38.0	35.5	112	81.9	76.4	172	125.8	117.3	232	169.7	158.2	292	213.6	199.1
53	38.8	36.1	113	82.6	77.1	173	126.5	118.0	233	170.4	158.9	293	214.3	199.8
54	39.5	36.8	114	83.4	77.7	174	127.3	118.7	234	171.1	159.6	294	215.0	200.5
55	40.2	37.5	115	84.1	78.4	175	128.0	119.3	235	171.9	160.3	295	215.7	201.2
56	41.0	38.2	116	84.8	79.1	176	128.7	120.0	236	172.6	161.0	296	216.5	201.9
57	41.7	38.9	117	85.6	79.8	177	129.4	120.7	237	173.3	161.6	297	217.2	202.6
58	42.4	39.6	118	86.3	80.5	178	130.2	121.4	238	174.1	162.3	298	217.9	203.2
59	43.1	40.2	119	87.0	81.2	179	130.9	122.1	239	174.8	163.0	299	218.7	203.9
60	43.9	40.9	120	87.8	81.8	180	131.6	122.8	240	175.5	163.7	300	219.4	204.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 47 Degrees.

TABLE II.

Difference of Latitude and Departure for 44 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	43.9	42.4	121	87.0	84.1	181	130.2	125.7	241	173.4	167.4
2	01.4	01.4	62	44.6	43.1	122	87.8	84.7	182	130.9	126.4	242	174.1	168.1
3	02.2	02.1	63	45.3	43.8	123	88.5	85.4	183	131.6	127.1	243	174.8	168.8
4	02.9	02.8	64	46.0	44.5	124	89.2	86.1	184	132.4	127.8	244	175.5	169.
5	03.6	03.5	65	46.8	45.2	125	89.9	86.8	185	133.1	128.5	245	176.2	170.2
6	04.3	04.2	66	47.5	45.8	126	90.6	87.5	186	133.8	129.2	246	177.0	170.9
7	05.0	04.9	67	48.2	46.5	127	91.4	88.2	187	134.5	129.9	247	177.7	171.6
8	05.8	05.6	68	48.9	47.2	128	92.1	88.9	188	135.2	130.6	248	178.4	172.3
9	06.5	06.3	69	49.6	47.9	129	92.8	89.6	189	136.0	131.3	249	179.1	173.0
10	07.2	06.9	70	50.4	48.6	130	93.5	90.3	190	136.7	132.0	250	179.8	173.7
11	07.9	07.6	71	51.1	49.3	131	94.2	91.0	191	137.4	132.7	251	180.6	174.4
12	08.6	08.3	72	51.8	50.0	132	95.0	91.7	192	138.1	133.4	252	181.3	175.1
13	09.4	09 0	73	52.5	50.7	133	95.7	92.4	193	138.8	134.1	253	182.0	175.7
14	10.1	09.7	74	53.2	51.4	134	96.4	93.1	194	139.6	134.8	254	182.7	176.4
15	10.8	10.4	75	54.0	52.1	135	97.1	93.8	195	140.3	135.5	255	183.4	177.1
16	11.5	11.1	76	54.7	52.8	136	97.8	94.5	196	141.0	136.2	256	184.2	177.8
17	12.2	11.8	77	55.4	53.5	137	98.5	95.2	197	141.7	136.8	257	184.9	178.5
18	12.9	12.5	78	56.1	54.2	138	99.3	95.9	198	142.4	137.5	258	185.6	179.2
19	13.7	13.2	79	56.8	54.9	139	100.0	96.6	199	143.1	138.2	259	186.3	179.9
20	14.4	13.9	80	57.5	55.6	140	100.7	97.3	200	143.9	138.9	260	187.0	180.6
21	15.1	14.6	81	58.3	56.3	141	101.4	97.9	201	144.6	139.6	261	187.7	181.3
22	15.8	15.3	82	59.0	57.0	142	102.1	98.6	202	145.3	140.3	262	188.5	182.0
23	16.5	16.0	83	59.7	57.7	143	102.9	99.3	203	146.0	141.0	263	189.2	182.7
24	17.3	16.7	84	60.4	58.4	144	103.6	100.0	204	146.7	141.7	264	189.9	183.4
25	18.0	17.4	85	61.1	59.0	145	104.3	100.7	205	147.5	142.4	265	190.6	184.1
26	18.7	18.1	86	61.9	59.7	146	105.0	101.4	206	148.2	143.1	266	191.3	184.8
27	19.4	18.8	87	62.6	60.4	147	105.7	102.1	207	148.9	143.8	267	192.1	185.5
28	20.1	19.5	88	63.3	61.1	148	106.5	102.8	208	149.6	144.5	268	192.8	186.2
29	20.9	20.1	89	64.0	61.8	149	107.2	103.5	209	150.3	145.2	269	193.5	186.9
30	21.6	20.8	90	64.7	62.5	150	107.9	104.2	210	151.1	145 9	270	194.2	187.6
31	22.3	21.5	91	65.5	63.2	151	108.6	104.9	211	151.8	146.6	271	194.9	188.3
32	23.0	22.2	92	66.2	63.9	152	109.3	105.6	212	152.5	147.3	272	195.7	188.9
33	23.7	22.9	93	66.9	64.6	153	110.1	106.3	213	153.2	148.0	273	196.4	189.6
34	24.5	23.6	94	67.6	65.3	154	110.8	107.0	214	153.9	148.7	274	197.1	190.3
35	25.2	24.3	95	68.3	66.0	155	111.5	107.7	215	154.7	149.4	275	197.8	191.0
36	25.9	25.0	96	69.1	66.7	156	112.2	108.4	216	155.4	150.0	276	198.5	191.7
37	26.6	25.7	97	69.8	67.4	157	112.9	109.1	217	156.1	150.7	277	199.3	192.4
38	27.3	26.4	98	70.5	68.1	158	113.7	109.8	218	156.8	151.4	278	200.0	193.1
39	28.1	27.1	99	71.2	68.8	159	114.4	110.5	219	157.5	152.1	279	200.7	193.8
40	28.8	27.8	100	71.9	69.5	160	115.1	111.1	220	158.3	152.8	280	201.4	194.5
41	29.5	28.5	101	72.7	70.2	161	115.8	111.8	221	159.0	153.5	281	202.1	195.2
42	30.2	29.2	102	73.4	70.9	162	116.5	112.5	222	159.7	154.2	282	202.9	195.9
43	30.9	29.9	103	74.1	71.5	163	117.3	113.2	223	160.4	154.9	283	203.6	196.6
44	31.7	30.6	104	74.8	72.2	164	118.0	113.9	224	161.1	155.6	284	204.3	197.3
45	32.4	31.3	105	75.5	72.9	165	118.7	114.6	225	161.9	156.3	285	205.0	198.0
46	33.1	32.0	106	76.3	73.6	166	119.4	115.3	226	162.6	157.0	286	205.7	198.7
47	33.8	32.6	107	77.0	74.3	167	120.1	116.0	227	163.3	157.7	287	206.5	199.4
48	34.5	33.3	108	77.7	75.0	168	120.8	116.7	228	164.0	158.4	288	207.2	200.1
49	35.2	34.0	109	78.4	75.7	169	121.6	117.4	229	164.7	159.1	289	207.9	200.8
50	36.0	34.7	110	79.1	76.4	170	122.3	118.1	230	165.4	159.8	290	208.6	201.5
51	36.7	35.4	111	79.8	77.1	171	123.0	118.8	231	166.2	160.5	291	209.3	202.1
52	37.4	36.1	112	80.6	77.8	172	123.7	119.5	232	166.9	161.2	292	210.0	202.8
53	38.1	36.8	113	81.3	78.5	173	124.4	120.2	233	167.6	161.9	293	210.8	203.5
54	38.8	37.5	114	82.0	79.2	174	125.2	120.9	234	168.3	162.6	294	211.5	204.2
55	39.6	38.2	115	82.7	79.9	175	125.9	121.6	235	169.0	163.2	295	212.2	204.9
56	40.3	38.9	116	83.4	80.6	176	126.6	122.3	236	169.8	163.9	296	212.9	205.6
57	41.0	39.6	117	84.2	81.3	177	127.3	123.0	237	170.5	164.6	297	213.6	206.3
58	41.7	40.3	118	84.9	82.0	178	128.0	123.6	238	171.2	165.3	298	214.4	207.0
59	42.4	41.0	119	85.6	82.7	179	128.8	124.3	239	171.9	166.0	299	215.1	207.7
60	43.2	41.7	120	86.3	83.4	180	129.5	125.0	240	172.6	166.7	300	215.8	208.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 46 Degrees.

TABLE II

Difference of Latitude and Departure for 45 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	43.1	43.1	121	85.6	85.6	181	128.0	128.0	241	170.4	170.4
2	01.4	01.4	62	43.8	43.8	122	86.3	86.3	182	128.7	128.7	242	171.1	171.1
3	02.1	02.1	63	44.5	44.5	123	87.0	87.0	183	129.4	129.4	243	171.8	171.8
4	02.8	02.8	64	45.3	45.3	124	87.7	87.7	184	130.1	130.1	244	172.5	172.5
5	03.5	03.5	65	46.0	46.0	125	88.4	88.4	185	130.8	130.8	245	173.2	173.2
6	04.2	04.2	66	46.7	46.7	126	89.1	89.1	186	131.5	131.5	246	173.9	173.9
7	04.9	04.9	67	47.4	47.4	127	89.8	89.8	187	132.2	132.2	247	174.7	174.7
8	05.7	05.7	68	48.1	48.1	128	90.5	90.5	188	132.9	132.9	248	175.4	175.4
9	06.4	06.4	69	48.8	48.8	129	91.2	91.2	189	133.6	133.6	249	176.1	176.1
10	07.1	07.1	70	49.5	49.5	130	91.9	91.9	190	134.4	134.4	250	176.8	176.8
11	07.8	07.8	71	50.2	50.2	131	92.6	92.6	191	135.1	135.1	251	177.5	177.5
12	08.5	08.5	72	50.9	50.9	132	93.3	93.3	192	135.8	135.8	252	178.2	178.2
13	09.2	09.2	73	51.6	51.6	133	94.0	94.0	193	136.5	136.5	253	178.9	178.9
14	09.9	09.9	74	52.3	52.3	134	94.8	94.8	194	137.2	137.2	254	179.6	179.6
15	10.6	10.6	75	53.0	53.0	135	95.5	95.5	195	137.9	137.9	255	180.3	180.3
16	11.3	11.3	76	53.7	53.7	136	96.2	96.2	196	138.6	138.6	256	181.0	181.0
17	12.0	12.0	77	54.4	54.4	137	96.9	96.9	197	139.3	139.3	257	181.7	181.7
18	12.7	12.7	78	55.2	55.2	138	97.6	97.6	198	140.0	140.0	258	182.4	182.4
19	13.4	13.4	79	55.9	55.9	139	98.3	98.3	199	140.7	140.7	259	183.1	183.1
20	14.1	14.1	80	56.6	56.6	140	99.0	99.0	200	141.4	141.4	260	183.8	183.8
21	14.8	14.8	81	57.3	57.3	141	99.7	99.7	201	142.1	142.1	261	184.6	184.6
22	15.6	15.6	82	58.0	58.0	142	100.4	100.4	202	142.8	142.8	262	185.3	185.3
23	16.3	16.3	83	58.7	58.7	143	101.1	101.1	203	143.5	143.5	263	186.0	186.0
24	17.0	17.0	84	59.4	59.4	144	101.8	101.8	204	144.2	144.2	264	186.7	186.7
25	17.7	17.7	85	60.1	60.1	145	102.5	102.5	205	145.0	145.0	265	187.4	187.4
26	18.4	18.4	86	60.8	60.8	146	103.2	103.2	206	145.7	145.7	266	188.1	188.1
27	19.1	19.1	87	61.5	61.5	147	103.9	103.9	207	146.4	146.4	267	188.8	188.8
28	19.8	19.8	88	62.2	62.2	148	104.7	104.7	208	147.1	147.1	268	189.5	189.5
29	20.5	20.5	89	62.9	62.9	149	105.4	105.4	209	147.8	147.8	269	190.2	190.2
30	21.2	21.2	90	63.6	63.6	150	106.1	106.1	210	148.5	148.5	270	190.9	190.9
31	21.9	21.9	91	64.3	64.3	151	106.8	106.8	211	149.2	149.2	271	191.6	191.6
32	22.6	22.6	92	65.1	65.1	152	107.5	107.5	212	149.0	149.9	272	192.3	192.3
33	23.3	23.3	93	65.8	65.8	153	108.2	108.2	213	150.6	150.6	273	193.0	193.0
34	24.0	24.0	94	66.5	66.5	154	108.9	108.9	214	151.3	151.3	274	193.7	193.7
35	24.7	24.7	95	67.2	67.2	155	109.6	109.6	215	152.0	152.0	275	194.5	194.5
36	25.5	25.5	96	67.9	67.9	156	110.3	110.3	216	152.7	152.7	276	195.2	195.2
37	26.2	26.2	97	68.6	68.6	157	111.0	111.0	217	153.4	153.4	277	195.9	195.9
38	26.9	26.9	98	69.3	69.3	158	111.7	111.7	218	154.1	154.1	278	196.6	196.6
39	27.6	27.6	99	70.0	70.0	159	112.4	112.4	219	154.9	154.9	279	197.3	197.3
40	28.3	28.3	100	70.7	70.7	160	113.1	113.1	220	155.6	155.6	280	198.0	198.0
41	29.0	29.0	101	71.4	71.4	161	113.8	113.8	221	156.3	156.3	281	198.7	198.7
42	29.7	29.7	102	72.1	72.1	162	114.6	114.6	222	157.0	157.0	282	199.4	199.4
43	30.4	30.4	103	72.8	72.8	163	115.3	115.3	223	157.7	157.7	283	200.1	200.1
44	31.1	31.1	104	73.5	73.5	164	116.0	116.0	224	158.4	158.4	284	200.8	200.8
45	31.8	31.8	105	74.2	74.2	165	116.7	116.7	225	159.1	159.1	285	201.5	201.5
46	32.5	32.5	106	75.0	75.0	166	117.4	117.4	226	159.8	159.8	286	202.2	202.2
47	33.2	33.2	107	75.7	75.7	167	118.1	118.1	227	160.5	160.5	287	202.9	202.9
48	33.9	33.9	108	76.4	76.4	168	118.8	118.8	228	161.2	161.2	288	203.6	203.6
49	34.6	34.6	109	77.1	77.1	169	119.5	119.5	229	161.9	161.9	289	204.4	204.4
50	35.4	35.4	110	77.8	77.8	170	120.2	120.2	230	162.6	162.6	290	205.1	205.1
51	36.1	36.1	111	78.5	78.5	171	120.9	120.9	231	163.3	163.3	291	205.8	205.8
52	36.8	36.8	112	79.2	79.2	172	121.6	121.6	232	164.0	164.0	292	206.5	206.5
53	37.5	37.5	113	79.9	79.9	173	122.3	122.3	233	164.8	164.8	293	207.2	207.2
54	38.2	38.2	114	80.6	80.6	174	123.0	123.0	234	165.5	165.5	294	207.9	207.9
55	38.9	38.9	115	81.3	81.3	175	123.7	123.7	235	166.2	166.2	295	208.6	208.6
56	39.6	39.6	116	82.0	82.0	176	124.5	124.5	236	166.9	166.9	296	209.3	209.3
57	40.3	40.3	117	82.7	82.7	177	125.2	125.2	237	167.6	167.6	297	210.0	210.0
58	41.0	41.0	118	83.4	83.4	178	125.9	125.9	238	168.3	168.3	298	210.7	210.7
59	41.7	41.7	119	84.1	84.1	179	126.6	126.6	239	169.0	169.0	299	211.4	211.4
60	42.4	42.4	120	84.9	84.9	180	127.3	127.3	240	169.7	169.7	300	212.1	212.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE III.

MERIDIONAL PARTS.

M	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	M
0	0	60	120	180	240	300	361	421	482	542	603	664	725	787	848	910	0
1	1	61	121	181	241	301	362	422	483	543	604	665	726	788	850	911	1
2	2	62	122	182	242	302	363	423	484	544	605	666	727	789	851	913	2
3	3	63	123	183	243	303	364	424	485	545	606	667	728	790	852	914	3
4	4	64	124	184	244	304	365	425	486	546	607	668	729	791	853	915	4
5	5	65	125	185	245	305	366	426	487	547	608	669	730	792	854	916	5
6	6	66	126	186	246	306	367	427	488	548	609	670	731	793	855	917	6
7	7	67	127	187	247	307	368	428	489	549	610	671	732	794	856	918	7
8	8	68	128	188	248	308	369	429	490	550	611	672	734	795	857	919	8
9	9	69	129	189	249	309	370	430	491	551	612	673	735	796	858	920	9
10	10	70	130	190	250	310	371	431	492	552	613	674	736	797	859	921	10
11	11	71	131	191	251	311	372	432	493	553	614	675	737	798	860	922	11
12	12	72	132	192	252	312	373	433	494	554	615	676	738	799	861	923	12
13	13	73	133	193	253	313	374	434	495	555	616	677	739	800	862	924	13
14	14	74	134	194	254	314	375	435	496	556	617	678	740	801	863	925	14
15	15	75	135	195	255	315	376	436	497	557	618	679	741	802	864	926	15
16	16	76	136	196	256	316	377	437	498	558	619	680	742	803	865	927	16
17	17	77	137	197	257	317	378	438	499	559	620	681	743	804	866	928	17
18	18	78	138	198	258	318	379	439	500	560	621	682	744	805	867	929	18
19	19	79	139	199	259	319	380	440	501	561	622	683	745	806	868	930	19
20	20	80	140	200	260	320	381	441	502	562	623	684	746	807	869	931	20
21	21	81	141	201	261	321	382	442	503	564	624	685	747	808	870	932	21
22	22	82	142	202	262	322	383	443	504	565	625	687	748	809	871	933	22
23	23	83	143	203	263	323	384	444	505	566	626	688	749	810	872	934	23
24	24	84	144	204	264	324	385	445	506	567	627	689	750	811	873	935	24
25	25	85	145	205	265	325	386	446	507	568	628	690	751	812	874	936	25
26	26	86	146	206	266	326	387	447	508	569	629	691	752	813	875	937	26
27	27	87	147	207	267	327	388	448	509	570	631	692	753	815	876	938	27
28	28	88	148	208	268	328	389	449	510	571	632	693	754	816	877	939	28
29	29	89	149	209	269	330	390	450	511	572	633	694	755	817	878	941	29
30	30	90	150	210	270	331	391	451	512	573	634	695	756	818	879	942	30
31	31	91	151	211	271	332	392	452	513	574	635	696	757	819	880	943	31
32	32	92	152	212	272	333	393	453	514	575	636	697	758	820	882	944	32
33	33	93	153	213	273	334	394	454	515	576	637	698	759	821	883	945	33
34	34	94	154	214	274	335	395	455	516	577	638	699	760	822	884	946	34
35	35	95	155	215	275	336	396	456	517	578	639	700	761	823	885	947	35
36	36	96	156	216	276	337	397	457	518	579	640	701	762	824	886	948	36
37	37	97	157	217	277	338	398	458	519	580	641	702	763	825	887	949	37
38	38	98	158	218	278	339	399	459	520	581	642	703	764	826	888	950	38
39	39	99	159	219	279	340	400	460	521	582	643	704	765	827	889	951	39
40	40	100	160	220	280	341	401	461	522	583	644	705	766	828	890	952	40
41	41	101	161	221	281	342	402	462	523	584	645	706	767	829	891	953	41
42	42	102	162	222	282	343	403	463	524	585	646	707	768	830	892	954	42
43	43	103	163	223	283	344	404	464	525	586	647	708	769	831	893	955	43
44	44	104	164	224	284	345	405	465	526	587	648	709	770	832	894	956	44
45	45	105	165	225	285	346	406	466	527	588	649	710	771	833	895	957	45
46	46	106	166	226	286	347	407	467	528	589	650	711	772	834	896	958	46
47	47	107	167	227	287	348	408	468	529	590	651	712	773	835	897	959	47
48	48	108	168	228	288	349	409	469	530	591	652	713	774	836	898	960	48
49	49	109	169	229	289	350	410	470	531	592	653	714	775	837	899	961	49
50	50	110	170	230	290	351	411	471	532	593	654	715	777	838	900	962	50
51	51	111	171	231	291	352	412	472	533	594	655	716	778	839	901	963	51
52	52	112	172	232	292	353	413	473	534	595	656	717	779	840	902	964	52
53	53	113	173	233	293	354	414	474	535	596	657	718	780	841	903	965	53
54	54	114	174	234	294	355	415	476	536	597	658	719	781	842	904	966	5
55	55	115	175	235	295	356	416	477	537	598	659	720	782	843	905	968	55
56	56	116	176	236	296	357	417	478	538	599	660	721	783	844	906	969	56
57	57	117	177	237	297	358	418	479	539	600	661	722	784	845	907	970	57
58	58	118	178	238	298	359	419	480	540	601	662	723	785	846	908	971	58
59	59	119	179	239	299	360	420	481	541	602	663	724	786	847	909	972	59
M	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	M

TABLE III.

MERIDIONAL PARTS.

M	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	M
0	973	1035	1098	1161	1225	1289	1354	1419	1484	1550	1616	1684	1751	0
1	974	1036	1099	1163	1226	1290	1355	1420	1485	1551	1618	1685	1752	1
2	975	1037	1100	1164	1227	1291	1356	1421	1486	1552	1619	1686	1753	2
3	976	1038	1101	1165	1228	1292	1357	1422	1487	1553	1620	1687	1755	3
4	977	1039	1102	1166	1229	1293	1358	1423	1488	1554	1621	1688	1756	4
5	978	1041	1103	1167	1230	1295	1359	1424	1490	1556	1622	1689	1757	5
6	979	1042	1105	1168	1232	1296	1360	1425	1491	1557	1623	1690	1758	6
7	980	1043	1106	1169	1233	1297	1361	1426	1492	1558	1624	1691	1759	7
8	981	1044	1107	1170	1234	1298	1362	1427	1493	1559	1625	1693	1760	8
9	982	1045	1108	1171	1235	1299	1363	1428	1494	1560	1626	1694	1761	9
10	983	1046	1109	1172	1236	1300	1364	1430	1495	1561	1628	1695	1762	10
11	984	1047	1110	1173	1237	1301	1366	1431	1496	1562	1629	1696	1764	11
12	985	1048	1111	1174	1238	1302	1367	1432	1497	1563	1630	1697	1765	12
13	986	1049	1112	1175	1239	1303	1368	1433	1498	1564	1631	1698	1766	13
14	987	1050	1113	1176	1240	1304	1369	1434	1499	1565	1632	1699	1767	14
15	988	1051	1114	1177	1241	1305	1370	1435	1500	1567	1633	1700	1768	15
16	989	1052	1115	1178	1242	1306	1371	1436	1502	1568	1634	1701	1769	16
17	990	1053	1116	1179	1243	1307	1372	1437	1503	1569	1635	1703	1770	17
18	991	1054	1117	1181	1244	1308	1373	1438	1504	1570	1637	1704	1772	18
19	993	1055	1118	1182	1245	1310	1374	1439	1505	1571	1638	1705	1773	19
20	994	1056	1119	1183	1246	1311	1375	1440	1506	1572	1639	1706	1774	20
21	995	1057	1120	1184	1248	1312	1376	1441	1507	1573	1640	1707	1775	21
22	996	1058	1121	1185	1249	1313	1377	1443	1508	1574	1641	1708	1776	22
23	997	1059	1122	1186	1250	1314	1379	1444	1509	1575	1642	1709	1777	23
24	998	1060	1123	1187	1251	1315	1380	1445	1510	1577	1643	1711	1778	24
25	999	1061	1125	1188	1252	1316	1381	1446	1511	1578	1644	1712	1780	25
26	1000	1063	1126	1189	1253	1317	1382	1447	1513	1579	1645	1713	1781	26
27	1001	1064	1127	1190	1254	1318	1383	1448	1514	1580	1647	1714	1782	27
28	1002	1065	1128	1191	1255	1319	1384	1449	1515	1581	1648	1715	1783	28
29	1003	1066	1129	1192	1256	1320	1385	1450	1516	1582	1649	1716	1784	29
30	1004	1067	1130	1193	1257	1321	1386	1451	1517	1583	1650	1717	1785	30
31	1005	1068	1131	1194	1258	1222	1387	1452	1518	1584	1651	1718	1786	31
32	1006	1069	1132	1195	1259	1324	1388	1453	1519	1585	1652	1720	1787	32
33	1007	1070	1133	1196	1260	1325	1389	1455	1520	1586	1653	1721	1789	33
34	1008	1071	1134	1198	1261	1326	1390	1456	1521	1588	1654	1722	1790	34
35	1009	1072	1135	1199	1262	1327	1392	1457	1522	1589	1656	1723	1791	35
36	1010	1073	1136	1200	1264	1328	1393	1458	1524	1590	1657	1724	1792	36
37	1011	1074	1137	1201	1265	1329	1394	1459	1525	1591	1658	1725	1793	37
38	1012	1075	1138	1202	1266	1330	1395	1460	1526	1592	1659	1726	1794	38
39	1013	1076	1139	1203	1267	1331	1396	1461	1527	1593	1660	1727	1795	39
40	1014	1077	1140	1204	1268	1332	1397	1462	1528	1594	1661	1729	1797	40
41	1015	1078	1141	1205	1269	1333	1398	1463	1529	1595	1662	1730	1798	41
42	1016	1079	1142	1206	1270	1334	1399	1464	1530	1596	1663	1731	1799	42
43	1018	1080	1144	1207	1271	1335	1400	1465	1531	1598	1664	1732	1800	43
44	1019	1081	1145	1208	1272	1336	1401	1467	1532	1599	1666	1733	1801	44
45	1020	1082	1146	1209	1273	1338	1402	1468	1533	1600	1667	1734	1802	45
46	1021	1084	1147	1210	1274	1339	1403	1469	1535	1601	1668	1735	1803	46
47	1022	1085	1148	1211	1275	1340	1405	1470	1536	1602	1669	1736	1805	47
48	1023	1086	1149	1212	1276	1341	1406	1471	1537	1603	1670	1738	1806	48
49	1024	1087	1150	1213	1277	1342	1407	1472	1538	1604	1671	1739	1807	49
50	1025	1088	1151	1215	1278	1343	1408	1473	1539	1605	1672	1740	1808	50
51	1026	1089	1152	1216	1280	1344	1409	1474	1540	1606	1673	1741	1809	51
52	1027	1090	1153	1217	1281	1345	1410	1475	1541	1608	1675	1742	1810	52
53	1028	1091	1154	1218	1282	1346	1411	1476	1542	1609	1676	1743	1811	53
54	1029	1092	1155	1219	1283	1347	1412	1477	1543	1610	1677	1744	1813	54
55	1030	1093	1156	1220	1284	1348	1413	1479	1544	1611	1678	1746	1814	55
56	1031	1094	1157	1221	1285	1349	1414	1480	1546	1612	1679	1747	1815	56
57	1032	1095	1158	1222	1286	1350	1415	1481	1547	1613	1680	1748	1816	57
58	1033	1096	1159	1223	1287	1352	1416	1482	1548	1614	1681	1749	1817	58
59	1034	1097	1160	1224	1288	1353	1418	1483	1549	1615	1682	1750	1818	59
M	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	M

TABLE III.

MERIDIONAL PARTS.

M	29°	30°	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	M
0	1819	1888	1958	2028	2100	2171	2244	2318	2393	2468	2545	2623	2702	0
1	1821	1890	1959	2030	2101	2173	2246	2319	2394	2470	2546	2624	2703	1
2	1822	1891	1960	2031	2102	2174	2247	2320	2395	2471	2548	2625	2704	2
3	1823	1892	1962	2032	2103	2175	2248	2322	2396	2472	2549	2627	2706	3
4	1824	1893	1963	2033	2104	2176	2249	2323	2398	2473	2550	2628	2707	4
5	1825	1894	1964	2034	2105	2178	2250	2324	2399	2475	2551	2629	2708	5
6	1826	1895	1965	2035	2107	2179	2252	2325	2400	2476	2553	2631	2710	6
7	1827	1806	1966	2037	2108	2180	2253	2327	2401	2477	2554	2632	2711	7
8	1829	1898	1967	2038	2109	2181	2254	2328	2403	2478	2555	2633	2712	8
9	1830	1899	1969	2039	2110	2182	2255	2329	2404	2480	2557	2634	2714	9
10	1831	1900	1970	2040	2111	2184	2257	2330	2405	2481	2558	2636	2715	10
11	1832	1901	1971	2041	2113	2185	2258	2332	2406	2482	2559	2637	2716	11
12	1833	1902	1972	2043	2114	2186	2259	2333	2408	2484	2560	2638	2718	12
13	1834	1903	1973	2044	2115	2187	2260	2334	2409	2485	2562	2640	2719	13
14	1835	1905	1974	2045	2116	2188	2261	2335	2410	2486	2563	2641	2720	14
15	1837	1906	1976	2046	2117	2190	2263	2337	2411	2487	2564	2642	2722	15
16	1838	1907	1977	2047	2119	2191	2264	2338	2413	2489	2566	2644	2723	16
17	1839	1908	1978	2048	2120	2192	2265	2339	2414	2490	2567	2645	2724	17
18	1840	1909	1979	2050	2121	2193	2266	2340	2415	2491	2568	2646	2726	18
19	1841	1910	1980	2051	2122	2194	2268	2342	2416	2492	2569	2648	2727	19
20	1842	1912	1981	2052	2123	2196	2269	2343	2418	2494	2571	2649	2728	20
21	1843	1913	1983	2053	2125	2197	2270	2344	2419	2495	2572	2650	2729	21
22	1845	1914	1984	2054	2126	2198	2271	2345	2420	2496	2573	2651	2731	22
23	1846	1915	1985	2056	2127	2199	2272	2346	2422	2498	2575	2653	2732	23
24	1847	1916	1986	2057	2128	2200	2274	2348	2423	2499	2576	2654	2733	24
25	1848	1917	1987	2058	2129	2202	2275	2349	2424	2500	2577	2655	2735	25
26	1849	1918	1988	2059	2131	2203	2276	2350	2425	2501	2578	2657	2736	26
27	1850	1920	1990	2060	2132	2204	2277	2351	2427	2503	2580	2658	2737	27
28	1852	1921	1991	2061	2133	2205	2279	2353	2428	2504	2581	2659	2739	28
29	1853	1922	1992	2063	2134	2207	2280	2354	2429	2505	2582	2661	2740	29
30	1854	1923	1993	2064	2135	2208	2281	2355	2430	2506	2584	2662	2742	30
31	1855	1924	1994	2065	2137	2209	2282	2356	2432	2508	2585	2663	2743	31
32	1856	1925	1995	2066	2138	2210	2283	2358	2433	2509	2586	2665	2744	32
33	1857	1927	1997	2067	2139	2211	2285	2359	2434	2510	2588	2666	2746	33
34	1858	1928	1998	2069	2140	2213	2286	2360	2435	2512	2589	2667	2747	34
35	1860	1929	1999	2070	2141	2214	2287	2361	2437	2513	2590	2669	2748	35
36	1861	1930	2000	2071	2143	2215	2288	2363	2438	2514	2591	2670	2750	36
37	1862	1931	2001	2072	2144	2216	2290	2364	2439	2515	2593	2671	2751	37
38	1863	1932	2002	2073	2145	2217	2291	2365	2440	2517	2594	2673	2752	38
39	1864	1934	2004	2075	2146	2219	2292	2366	2442	2518	2595	2674	2754	39
40	1865	1935	2005	2076	2147	2220	2293	2368	2443	2519	2597	2675	2755	40
41	1866	1936	2006	2077	2149	2221	2295	2369	2444	2521	2598	2676	2756	41
42	1868	1937	2007	2078	2150	2222	2296	2370	2445	2522	2599	2678	2758	42
43	1869	1938	2008	2079	2151	2224	2297	2371	2447	2523	2601	2679	2759	43
44	1870	1939	2010	2080	2152	2225	2298	2373	2448	2524	2602	2680	2760	44
45	1871	1941	2011	2082	2153	2226	2299	2374	2449	2526	2603	2682	2762	45
46	1872	1942	2012	2083	2155	2227	2301	2375	2451	2527	2604	2683	2763	46
47	1873	1943	2013	2084	2156	2228	2302	2376	2452	2528	2606	2684	2764	47
48	1875	1944	2014	2085	2157	2230	2303	2378	2453	2530	2607	2686	2766	48
49	1876	1945	2015	2086	2158	2231	2304	2379	2454	2531	2608	2687	2767	49
50	1877	1946	2017	2088	2159	2232	2306	2380	2456	2532	2610	2688	2768	50
51	1878	1948	2018	2089	2161	2233	2307	2381	2457	2533	2611	2690	2770	51
52	1879	1949	2019	2090	2162	2235	2308	2383	2458	2535	2612	2691	2771	52
53	1880	1950	2020	2091	2163	2236	2309	2384	2459	2536	2614	2692	2772	53
54	1881	1951	2021	2092	2164	2237	2311	2385	2461	2537	2615	2694	2774	54
55	1883	1952	2022	2094	2165	2238	2312	2386	2462	2538	2616	2695	2775	55
56	1884	1953	2024	2095	2167	2239	2313	2388	2463	2540	2617	2696	2776	56
57	1885	1955	2025	2096	2168	2241	2314	2389	2464	2541	2619	2698	2778	57
58	1886	1956	2026	2097	2169	2242	2316	2390	2466	2542	2620	2699	2779	58
59	1887	1957	2027	2098	2170	2243	2317	2391	2467	2544	2621	2700	2780	59
M	29°	30°	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	M

TABLE III.

MERIDIONAL PARTS.

M	42°	43°	44°	45°	46°	47°	48°	49°	50°	51°	52°	53°	54°	M
0	2782	2863	2946	3030	3116	3203	3292	3382	3474	3569	3665	3764	3865	0
1	2783	2864	2947	3031	3117	3204	3293	3384	3476	3570	3667	3765	3866	1
2	2784	2866	2949	3033	3118	3206	3295	3385	3478	3572	3668	3767	3868	2
3	2786	2867	2950	3034	3120	3207	3296	3387	3479	3574	3670	3769	3870	3
4	2787	2869	2951	3036	3121	3209	3298	3388	3481	3575	3672	3770	3871	4
5	2788	2870	2953	3037	3123	3210	3299	3390	3482	3577	3673	3772	3873	5
6	2790	2871	2954	3038	3124	3212	3301	3391	3484	3578	3675	3774	3875	6
7	2791	2873	2956	3040	3126	3213	3302	3393	3485	3580	3677	3775	3877	7
8	2792	2874	2957	3041	3127	3214	3303	3394	3487	3582	3678	3777	3878	8
9	2794	2875	2958	3043	3129	3216	3305	3396	3488	3583	3680	3779	3880	9
10	2795	2877	2960	3044	3130	3217	3306	3397	3490	3585	3681	3780	3882	10
11	2797	2878	2961	3046	3131	3219	3308	3399	3492	3586	3683	3782	3883	11
12	2798	2880	2963	3047	3133	3220	3309	3400	3493	3588	3685	3784	3885	12
13	2799	2881	2964	3048	3134	3222	3311	3402	3495	3590	3686	3785	3887	13
14	2801	2882	2965	3050	3136	3223	3312	3403	3496	3591	3688	3787	3889	14
15	2802	2884	2967	3051	3137	3225	3314	3405	3498	3593	3690	3789	3890	15
16	2803	2885	2968	3053	3139	3226	3316	3407	3499	3594	3691	3790	3892	16
17	2805	2886	2970	3054	3140	3228	3317	3408	3501	3596	3693	3792	3894	17
18	2806	2888	2971	3055	3142	3229	3319	3410	3503	3598	3695	3794	3895	18
19	2807	2889	2972	3057	3143	3231	3320	3411	3504	3599	3696	3795	3897	19
20	2809	2891	2974	3058	3144	3232	3322	3413	3506	3601	3698	3797	3899	20
21	2810	2892	2975	3060	3146	3234	3323	3414	3507	3602	3699	3799	3901	21
22	2811	2893	2976	3061	3147	3235	3325	3416	3509	3604	3701	3800	3902	22
23	2813	2895	2978	3063	3149	3237	3326	3417	3510	3606	3703	3802	3904	23
24	2814	2896	2979	3064	3150	3238	3328	3419	3512	3607	3704	3804	3906	24
25	2815	2897	2981	3065	3152	3240	3329	3420	3514	3609	3706	3806	3907	25
26	2817	2899	2982	3067	3153	3241	3331	3422	3515	3610	3708	3807	3909	26
27	2818	2900	2983	3068	3155	3242	3332	3423	3517	3612	3709	3809	3911	27
28	2820	2902	2985	3070	3156	3244	3334	3425	3518	3614	3711	3811	3913	28
29	2821	2903	2986	3071	3157	3245	3335	3427	3520	3615	3713	3812	3914	29
30	2822	2904	2988	3073	3159	3247	3337	3428	3521	3617	3714	3814	3916	30
31	2824	2906	2989	3074	3160	3248	3338	3430	3523	3618	3716	3816	3918	31
32	2825	2907	2991	3075	3162	3250	3340	3431	3525	3620	3717	3817	3919	32
33	2826	2908	2992	3077	3163	3251	3341	3433	3526	3622	3719	3819	3921	33
34	2828	2910	2993	3078	3165	3253	3343	3434	3528	3623	3721	3821	3923	34
35	2829	2911	2995	3080	3166	3254	3344	3436	3529	3625	3722	3822	3925	35
36	2830	2913	2996	3081	3168	3256	3346	3437	3531	3626	3724	3824	3926	36
37	2832	2914	2998	3083	3169	3257	3347	3439	3532	3628	3726	3826	3928	37
38	2833	2915	2999	3084	3171	3259	3349	3440	3534	3630	3727	3827	3930	38
39	2834	2917	3000	3085	3172	3260	3350	3442	3536	3631	3729	3829	3932	39
40	2836	2918	3002	3087	3173	3262	3352	3443	3537	3633	3731	3831	3933	40
41	2837	2919	3003	3088	3175	3263	3353	3445	3539	3634	3732	3832	3935	41
42	2839	2921	3005	3090	3176	3265	3355	3447	3540	3636	3734	3834	3937	42
43	2840	2922	3006	3091	3178	3266	3356	3448	3542	3638	3736	3836	3938	43
44	2841	2924	3007	3093	3179	3268	3358	3450	3543	3639	3737	3838	3940	44
45	2843	2925	3009	3094	3181	3269	3359	3451	3545	3641	3739	3839	3942	45
46	2844	2926	3010	3095	3182	3271	3361	3453	3547	3643	3741	3841	3944	46
47	2845	2928	3012	3097	3184	3272	3362	3454	3548	3644	3742	3843	3945	47
48	2847	2929	3013	3098	3185	3274	3364	3456	3550	3646	3744	3844	3947	48
49	2848	2931	3014	3100	3187	3275	3365	3457	3551	3647	3746	3846	3949	49
50	2849	2932	3016	3101	3188	3277	3367	3459	3553	3649	3747	3848	3951	50
51	2851	2933	3017	3103	3190	3278	3368	3460	3555	3651	3749	3849	3952	51
52	2852	2935	3019	3104	3191	3280	3370	3462	3556	3652	3750	3851	3954	52
53	2854	2936	3020	3105	3192	3281	3371	3464	3558	3654	3752	3853	3956	53
54	2855	2937	3021	3107	3194	3283	3373	3465	3559	3655	3754	3854	3958	54
55	2856	2939	3023	3108	3195	3284	3374	3467	3561	3657	3755	3856	3959	55
56	2858	2940	3024	3110	3197	3286	3376	3468	3562	3659	3757	3858	3961	56
57	2859	2942	3026	3111	3198	3287	3378	3470	3564	3660	3759	3860	3963	57
58	2860	2943	3027	3113	3200	3289	3379	3471	3566	3662	3760	3861	3964	58
59	2862	2944	3029	3114	3201	3290	3381	3473	3567	3664	3762	3863	3966	59
M	42°	43°	44°	45°	46°	47°	48°	49°	50°	51°	52°	53°	54°	M

TABLE III.

MERIDIONAL PARTS.

M	55°	56°	57°	58°	59°	60°	61°	62°	63°	64°	65°	66°	67°	M
0	3968	4074	4183	4294	4409	4527	4649	4775	4905	5039	5179	5324	5474	0
1	3970	4076	4184	4296	4411	4529	4651	4777	4907	5042	5181	5326	5477	1
2	3971	4077	4186	4298	4413	4531	4653	4779	4909	5044	5184	5328	5479	2
3	3973	4079	4188	4300	4415	4533	4655	4781	4912	5046	5186	5331	5482	3
4	3975	4081	4190	4302	4417	4535	4657	4784	4914	5049	5188	5333	5484	4
5	3977	4083	4192	4304	4419	4537	4660	4786	4916	5051	5191	5336	5487	5
6	3978	4085	4194	4306	4421	4539	4662	4788	4918	5053	5193	5338	5489	6
7	3980	4086	4195	4308	4423	4541	4664	4790	4920	5055	5195	5341	5492	7
8	3982	4088	4197	4309	4425	4543	4666	4792	4923	5058	5198	5343	5495	8
9	3984	4090	4199	4311	4427	4545	4668	4794	4925	5060	5200	5346	5497	9
10	3985	4092	4201	4313	4429	4547	4670	4796	4927	5062	5203	5348	5500	10
11	3987	4094	4203	4315	4431	4549	4672	4798	4929	5065	5205	5351	5502	11
12	3989	4095	4205	4317	4433	4551	4674	4801	4931	5067	5207	5353	5505	12
13	3991	4097	4207	4319	4434	4553	4676	4803	4934	5069	5210	5356	5507	13
14	3992	4099	4208	4321	4436	4555	4678	4805	4936	5071	5212	5358	5510	14
15	3994	4101	4210	4323	4438	4557	4680	4807	4938	5074	5214	5361	5513	15
16	3996	4103	4212	4325	4440	4559	4682	4809	4940	5076	5217	5363	5515	16
17	3998	4104	4214	4327	4442	4562	4684	4811	4943	5078	5219	5366	5518	17
18	3999	4106	4216	4328	4444	4564	4687	4814	4945	5081	5222	5368	5520	18
19	4001	4108	4218	4330	4446	4566	4689	4816	4947	5083	5224	5371	5523	19
20	4003	4110	4220	4332	4448	4568	4691	4818	4949	5085	5226	5373	5526	20
21	4005	4112	4221	4334	4450	4570	4693	4820	4951	5088	5229	5376	5528	21
22	4006	4113	4223	4336	4452	4572	4695	4822	4954	5090	5231	5378	5531	22
23	4008	4115	4225	4338	4454	4574	4697	4824	4956	5092	5234	5380	5533	23
24	4010	4117	4227	4340	4456	4576	4699	4826	4958	5095	5236	5383	5536	24
25	4012	4119	4229	4342	4458	4578	4701	4829	4960	5097	5238	5385	5539	25
26	4014	4121	4231	4344	4460	4580	4703	4831	4963	5099	5241	5388	5541	26
27	4015	4122	4232	4346	4462	4582	4705	4833	4965	5102	5243	5390	5544	27
28	4017	4124	4234	4347	4464	4584	4707	4835	4967	5104	5246	5393	5546	28
29	4019	4126	4236	4349	4466	4586	4710	4837	4969	5106	5248	5395	5549	29
30	4021	4128	4238	4351	4468	4588	4712	4839	4972	5108	5250	5398	5552	30
31	4022	4130	4240	4353	4470	4590	4714	4842	4974	5111	5253	5401	5554	31
32	4024	4132	4242	4355	4472	4592	4716	4844	4976	5113	5255	5403	5557	32
33	4026	4133	4244	4357	4474	4594	4718	4846	4978	5115	5258	5406	5559	33
34	4028	4135	4246	4359	4476	4596	4720	4848	4981	5118	5260	5408	5562	34
35	4029	4137	4247	4361	4478	4598	4722	4850	4983	5120	5263	5411	5565	35
36	4031	4139	4249	4363	4480	4600	4724	4852	4985	5122	5265	5413	5567	36
37	4033	4141	4251	4365	4482	4602	4726	4855	4987	5125	5267	5416	5570	37
38	4035	4142	4253	4367	4484	4604	4728	4857	4990	5127	5270	5418	5573	38
39	4037	4144	4255	4369	4486	4606	4731	4859	4992	5129	5272	5421	5575	39
40	4038	4146	4257	4370	4488	4608	4733	4861	4994	5132	5275	5423	5578	40
41	4040	4148	4259	4372	4490	4610	4735	4863	4996	5134	5277	5426	5580	41
42	4042	4150	4260	4374	4492	4612	4737	4865	4999	5136	5280	5428	5583	42
43	4044	4152	4262	4376	4494	4614	4739	4868	5001	5139	5282	5431	5586	43
44	4045	4153	4264	4378	4495	4616	4741	4870	5003	5141	5284	5433	5588	44
45	4047	4155	4266	4380	4497	4618	4743	4872	5005	5143	5287	5436	5591	45
46	4049	4157	4268	4382	4499	4620	4745	4874	5008	5146	5289	5438	5594	46
47	4051	4159	4270	4384	4501	4623	4747	4876	5010	5148	5292	5441	5596	47
48	4052	4161	4272	4386	4503	4625	4750	4879	5012	5151	5294	5443	5599	48
49	4054	4162	4274	4388	4505	4627	4752	4881	5014	5153	5297	5446	5602	49
50	4056	4164	4275	4390	4507	4629	4754	4883	5017	5155	5299	5448	5604	50
51	4058	4166	4277	4392	4509	4631	4756	4885	5019	5158	5301	5451	5607	51
52	4060	4168	4279	4394	4511	4633	4758	4887	5021	5160	5304	5454	5610	52
53	4061	4170	4281	4396	4513	4635	4760	4890	5023	5162	5306	5456	5612	53
54	4063	4172	4283	4398	4515	4637	4762	4892	5026	5165	5309	5459	5615	54
55	4065	4173	4285	4399	4517	4639	4764	4894	5028	5167	5311	5461	5617	55
56	4067	4175	4287	4401	4519	4641	4766	4896	5030	5169	5314	5464	5620	56
57	4069	4177	4289	4403	4521	4643	4769	4898	5033	5172	5316	5466	5623	57
58	4070	4179	4291	4405	4523	4645	4771	4901	5035	5174	5319	5469	5625	58
59	4072	4181	4292	4407	4525	4647	4773	4903	5037	5176	5321	5471	5628	59
M	55°	56°	57°	58°	59°	60°	61°	62°	63°	64°	65°	66°	67°	M

TABLE III.

MERIDIONAL PARTS.

M	68°	69°	70°	71°	72°	73°	74°	75°	76°	77°	78°	79°	80°	M
0	5631	5795	5966	6146	6335	6534	6746	6970	7210	7467	7745	8046	8375	0
1	5633	5797	5969	6149	6338	6538	6749	6974	7214	7472	7749	8051	8381	1
2	5636	5800	5972	6152	6341	6541	6753	6978	7218	7476	7754	8056	8387	2
3	5639	5803	5975	6155	6345	6545	6757	6982	7222	7481	7759	8061	8393	3
4	5642	5806	5978	6158	6348	6548	6760	6986	7227	7485	7764	8067	8398	4
5	5644	5809	5981	6161	6351	6552	6764	6990	7231	7490	7769	8072	8404	5
6	5647	5811	5984	6164	6354	6555	6768	6994	7235	7494	7774	8077	8410	6
7	5650	5814	5986	6167	6358	6558	6771	6997	7239	7498	7778	8083	8416	7
8	5652	5817	5989	6170	6361	6562	6775	7001	7243	7503	7783	8088	8422	8
9	5655	5820	5992	6173	6364	6565	6779	7005	7247	7507	7788	8093	8427	9
10	5658	5823	5995	6177	6367	6569	6782	7009	7252	7512	7793	8099	8433	10
11	5660	5825	5998	6180	6371	6572	6786	7013	7256	7516	7798	8104	8439	11
12	5663	5828	6001	6183	6374	6576	6790	7017	7260	7521	7803	8109	8445	12
13	5666	5831	6004	6186	6377	6579	6793	7021	7264	7525	7808	8115	8451	13
14	5668	5834	6007	6189	6380	6583	6797	7025	7268	7530	7813	8120	8457	14
15	5671	5837	6010	6192	6384	6586	6801	7029	7273	7535	7817	8125	8463	15
16	5674	5839	6013	6195	6387	6590	6804	7033	7277	7539	7822	8131	8469	16
17	5676	5842	6016	6198	6390	6593	6808	7037	7281	7544	7827	8136	8474	17
18	5679	5845	6019	6201	6394	6597	6812	7041	7285	7548	7832	8141	8480	18
19	5682	5848	6022	6205	6397	6600	6815	7045	7289	7553	7837	8147	8486	19
20	5685	5851	6025	6208	6400	6603	6819	7048	7294	7557	7842	8152	8492	20
21	5687	5854	6028	6211	6403	6607	6823	7052	7298	7562	7847	8158	8498	21
22	5690	5856	6031	6214	6407	6610	6826	7056	7302	7566	7852	8163	8504	22
23	5693	5859	6034	6217	6410	6614	6830	7060	7306	7571	7857	8168	8510	23
24	5695	5862	6037	6220	6413	6617	6834	7064	7311	7576	7862	8174	8516	24
25	5698	5865	6040	6223	6417	6621	6838	7068	7315	7580	7867	8179	8522	25
26	5701	5868	6043	6226	6420	6624	6841	7072	7319	7585	7872	8185	8528	26
27	5704	5871	6046	6230	6423	6628	6845	7076	7323	7589	7877	8190	8534	27
28	5706	5874	6049	6233	6427	6631	6849	7080	7328	7594	7882	8196	8540	28
29	5709	5876	6052	6236	6430	6635	6853	7084	7332	7599	7887	8201	8546	29
30	5712	5879	6055	6239	6433	6639	6856	7088	7336	7603	7892	8207	8552	30
31	5715	5882	6058	6242	6437	6642	6860	7092	7341	7608	7897	8212	8558	31
32	5717	5885	6061	6245	6440	6646	6864	7096	7345	7612	7902	8218	8565	32
33	5720	5888	6064	6249	6443	6649	6868	7100	7349	7617	7907	8223	8571	33
34	5723	5891	6067	6252	6447	6653	6871	7104	7353	7622	7912	8229	8577	34
35	5725	5894	6070	6255	6450	6656	6875	7108	7358	7626	7917	8234	8583	35
36	5728	5896	6073	6258	6453	6660	6879	7112	7362	7631	7922	8240	8589	36
37	5731	5899	6076	6261	6457	6663	6883	7116	7366	7636	7927	8245	8595	37
38	5734	5902	6079	6264	6460	6667	6886	7120	7371	7640	7932	8251	8601	38
39	5736	5905	6082	6268	6463	6670	6890	7124	7375	7645	7937	8256	8607	39
40	5739	5908	6085	6271	6467	6674	6894	7128	7379	7650	7942	8262	8614	40
41	5742	5911	6088	6274	6470	6677	6898	7132	7384	7654	7948	8267	8620	41
42	5745	5914	6091	6277	6473	6681	6901	7136	7388	7659	7953	8273	8626	42
43	5747	5917	6094	6280	6477	6685	6905	7140	7392	7664	7958	8279	8632	43
44	5750	5919	6097	6283	6480	6688	6909	7145	7397	7668	7963	8284	8638	44
45	5753	5922	6100	6287	6483	6692	6913	7149	7401	7673	7968	8290	8644	45
46	5756	5925	6103	6290	6487	6695	6917	7153	7406	7678	7973	8295	8651	46
47	5758	5928	6106	6293	6490	6699	6920	7157	7410	7683	7978	8301	8657	47
48	5761	5931	6109	6296	6494	6702	6924	7161	7414	7687	7983	8307	8663	48
49	5764	5934	6112	6299	6497	6706	6928	7165	7419	7692	7989	8312	8669	49
50	5767	5937	6115	6303	6500	6710	6932	7169	7423	7697	7994	8318	8676	50
51	5770	5940	6118	6306	6504	6713	6936	7173	7427	7702	7999	8324	8682	51
52	5772	5943	6121	6309	6507	6717	6940	7177	7432	7706	8004	8329	8688	52
53	5775	5946	6124	6312	6511	6720	6943	7181	7436	7711	8009	8335	8695	53
54	5778	5948	6127	6315	6514	6724	6947	7185	7441	7716	8014	8341	8701	54
55	5781	5951	6130	6319	6517	6728	6951	7189	7445	7721	8020	8347	8707	55
56	5783	5954	6133	6322	6521	6731	6955	7194	7449	7725	8025	8352	8714	56
57	5786	5957	6136	6325	6524	6735	6959	7198	7454	7730	8030	8358	8720	57
58	5789	5960	6140	6328	6528	6738	6963	7202	7458	7735	8035	8364	8726	58
59	5792	5963	6143	6332	6531	6742	6966	7206	7463	7740	8040	8369	8732	59
M	68°	69°	70°	71°	72°	73°	74°	75°	76°	77°	78°	79°	80°	M

TABLE IV.

MEAN REFRACTION.

App. Alt. ° '	Refr. ' "	App. Alt. ° '	Refr. ' "	App. Alt. ° '	Refr. ' "	App. Alt. ° '	Refr. ' "	App. Alt. ° '	Refr. ' "
0 0	33 0	5 0	9 54	10 0	5 15	20 0	2 35	34 0	1 24
0 5	32 10	5 5	9 46	10 10	5 10	20 10	2 34	34 30	1 23
0 10	31 22	5 10	9 38	10 20	5 5	20 20	2 32	35 0	1 21
0 15	30 35	5 15	9 30	10 30	5 0	20 30	2 31	35 30	1 20
0 20	29 50	5 20	9 23	10 40	4 56	20 40	2 29	36 0	1 18
0 25	29 6	5 25	9 15	10 50	4 51	20 50	2 28	36 30	1 17
0 30	28 23	5 30	9 8	11 0	4 47	21 0	2 27	37 0	1 16
0 35	27 41	5 35	9 1	11 10	4 43	21 10	2 26	37 30	1 14
0 40	27 0	5 40	8 54	11 20	4 39	21 20	2 25	38 0	1 13
0 45	26 20	5 45	8 47	11 30	4 34	21 30	2 24	38 30	1 11
0 50	25 42	5 50	8 41	11 40	4 31	21 40	2 23	39 0	1 10
0 55	25 5	5 55	8 34	11 50	4 27	21 50	2 21	39 30	1 9
1 0	24 29	6 0	8 28	12 0	4 23	22 0	2 20	40 0	1 8
1 5	23 54	6 5	8 21	12 10	4 20	22 10	2 19	41 0	1 5
1 10	23 20	6 10	8 15	12 20	4 16	22 20	2 18	42 0	1 3
1 15	22 47	6 15	8 9	12 30	4 13	22 30	2 17	43 0	1 1
1 20	22 15	6 20	8 3	12 40	4 9	22 40	2 16	44 0	0 59
1 25	21 44	6 25	7 57	12 50	4 6	22 50	2 15	45 0	0 57
1 30	21 15	6 30	7 51	13 0	4 3	23 0	2 14	46 0	0 55
1 35	20 46	6 35	7 45	13 10	4 0	23 10	2 13	47 0	0 53
1 40	20 18	6 40	7 40	13 20	3 57	23 20	2 12	48 0	0 51
1 45	19 51	6 45	7 35	13 30	3 54	23 30	2 11	49 0	0 49
1 50	19 25	6 50	7 30	13 40	3 51	23 40	2 10	50 0	0 48
1 55	19 0	6 55	7 25	13 50	3 48	23 50	2 9	51 0	0 46
2 0	18 35	7 0	7 20	14 0	3 45	24 0	2 8	52 0	0 44
2 5	18 11	7 5	7 15	14 10	3 43	24 10	2 7	53 0	0 43
2 10	17 48	7 10	7 11	14 20	3 40	24 20	2 6	54 0	0 41
2 15	17 26	7 15	7 6	14 30	3 38	24 30	2 5	55 0	0 40
2 20	17 4	7 20	7 2	14 40	3 35	24 40	2 4	56 0	0 38
2 25	16 44	7 25	6 57	14 50	3 33	24 50	2 3	57 0	0 37
2 30	16 24	7 30	6 53	15 0	3 30	25 0	2 2	58 0	0 35
2 35	16 4	7 35	6 49	15 10	3 28	25 10	2 1	59 0	0 34
2 40	15 45	7 40	6 45	15 20	3 26	25 20	2 0	60 0	0 33
2 45	15 27	7 45	6 41	15 30	3 24	25 30	1 59	61 0	0 32
2 50	15 9	7 50	6 37	15 40	3 21	25 40	1 58	62 0	0 30
2 55	14 52	7 55	6 33	15 50	3 19	25 50	1 57	63 0	0 29
3 0	14 36	8 0	6 29	16 0	3 17	26 0	1 56	64 0	0 28
3 5	14 20	8 5	6 25	16 10	3 15	26 10	1 55	65 0	0 26
3 10	14 4	8 10	6 22	16 20	3 12	26 20	1 55	66 0	0 25
3 15	13 49	8 15	6 18	16 30	3 10	26 30	1 54	67 0	0 24
3 20	13 34	8 20	6 15	16 40	3 8	26 40	1 53	68 0	0 23
3 25	13 20	8 25	6 11	16 50	3 6	26 50	1 52	69 0	0 22
3 30	13 6	8 30	6 8	17 0	3 4	27 0	1 51	70 0	0 21
3 35	12 53	8 35	6 5	17 10	3 3	27 15	1 50	71 0	0 19
3 40	12 40	8 40	6 1	17 20	3 1	27 30	1 49	72 0	0 18
3 45	12 27	8 45	5 58	17 30	2 59	27 45	1 48	73 0	0 17
3 50	12 15	8 50	5 55	17 40	2 57	28 0	1 47	74 0	0 16
3 55	12 3	8 55	5 52	17 50	2 55	28 15	1 46	75 0	0 15
4 0	11 51	9 0	5 48	18 0	2 54	28 30	1 45	76 0	0 14
4 5	11 40	9 5	5 45	18 10	2 52	28 45	1 44	77 0	0 13
4 10	11 29	9 10	5 42	18 20	2 51	29 0	1 42	78 0	0 12
4 15	11 18	9 15	5 39	18 30	2 49	29 30	1 40	79 0	0 11
4 20	11 8	9 20	5 36	18 40	2 47	30 0	1 38	80 0	0 10
4 25	10 58	9 25	5 34	18 50	2 46	30 30	1 37	81 0	0 9
4 30	10 48	9 30	5 31	19 0	2 44	31 0	1 35	82 0	0 8
4 35	10 39	9 35	5 28	19 10	2 43	31 30	1 33	83 0	0 7
4 40	10 29	9 40	5 25	19 20	2 41	32 0	1 31	84 0	0 6
4 45	10 20	9 45	5 23	19 30	2 40	32 30	1 30	86 0	0 4
4 50	10 11	9 50	5 20	19 40	2 38	33 0	1 28	88 0	0 2
4 55	10 2	9 55	5 18	19 50	2 37	33 30	1 26	90 0	0 0

TABLE V.

Dip of the Horizon.

Height Feet	Dip. ' "
1	0 58
2	1 21
3	1 40
4	1 56
5	2 9
6	2 21
7	2 33
8	2 44
9	2 53
10	3 2
11	3 10
12	3 19
13	3 27
14	3 36
15	3 42
16	3 50
17	3 57
18	4 4
19	4 11
20	4 17
21	4 23
22	4 30
23	4 36
24	4 42
26	4 52
28	5 5
30	5 15
35	5 39
40	6 4
45	6 27
50	6 46
60	7 25
70	8 1
80	8 34
90	9 6
100	9 35

TABLE VI.

Sun's Parallax in Alt.

Altit. °	Parall. "
0	9
10	9
20	8
30	8
40	7
50	6
55	5
60	4
65	4
70	3
75	2
80	2
85	1
90	0

TAB. VII.

Moon's Augmentat.

Alt. °	Augm. "
0	0
5	1
10	3
15	4
20	6
25	7
30	8
35	9
40	10
45	11
50	12
55	13
60	14
70	15
80	15
90	16

TABLE VIII.

Dip at differ. Distances from the Observer.

Miles.	Height of the Eye in Feet.					
	5	10	15	20	25	30
¼	11'	23'	34'	45'	57'	68'
½	6	12	17	23	28	34
¾	4	8	12	15	19	23
1	3	6	9	12	15	17
1¼	3	5	7	10	12	14
1½	3	4	6	8	10	12
2	2	4	5	7	8	9
2½	2	3	4	6	7	8
3	2	3	4	5	6	7
3½	2	3	4	5	6	6
4	2	3	4	5	5	6
5	2	3	4	4	5	6
6	2	3	4	4	5	5

TABLE IX.

For correcting the OBSERVED ALTITUDE of the SUN'S LOWER LIMB, when taken by a Fore Observation.

Obs. Alt.	Height of the Eye above the Sea in Feet.															
	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36
5° 0′	3′.8	3′.5	3′.1	2′.8	2′.5	2′.3	2′.1	1′.8	1′.6	1′.4	1′.2	1′.0	0′.8	0′.6	0′.5	0′.3
5 20	4.3	4.0	3.6	3.3	3.1	2.8	2.6	2.3	2.1	1.9	1.7	1.5	1.3	1.1	1.0	0.8
5 40	4.8	4.5	4.1	3.8	3.5	3.3	3.1	2.8	2.6	2.4	2.2	2.0	1.8	1.6	1.5	1.3
6 0	5.3	4.9	4.6	4.3	4.0	3.7	3.5	3.3	3.0	2.8	2.6	2.4	2.2	2.1	1.9	1.7
6 20	5.7	5.4	5.0	4.7	4.4	4.1	3.9	3.7	3.3	3.2	3.0	2.8	2.6	2.5	2.3	2.0
6 40	6.0	5.7	5.3	5.0	4.7	4.5	4.3	4.0	3.8	3.6	3.4	3.2	3.0	2.8	2.7	2.3
7 0	6.4	6.0	5.7	5.4	5.1	4.8	4.6	4.4	4.1	3.9	3.7	3.5	3.3	3.2	3.0	2.7
7 20	6.7	6.3	6.0	5.7	5.4	5.1	4.9	4.7	4.4	4.2	4.0	3.8	3.6	3.5	3.3	3.1
7 40	6.9	6.6	6.2	5.9	5.7	5.4	5.2	4.9	4.7	4.5	4.3	4.1	3.9	3.8	3.6	3.4
8 0	7.2	6.8	6.5	6.2	5.9	5.7	5.4	5.3	5.0	4.8	4.6	4.4	4.2	4.0	3.9	3.7
8 20	7.5	7.1	6.7	6.5	6.2	5.9	5.7	5.5	5.2	5.0	4.8	4.6	4.4	4.3	4.1	3.9
8 [illegible]	7.7	7.3	7.0	6.7	6.4	6.1	5.9	5.7	5.5	5.2	5.0	4.8	4.7	4.5	4.3	4.1
9 0	7.9	7.5	7.2	6.9	6.6	6.4	6.1	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.4
9 20	8.1	7.7	7.4	7.1	6 8	6.6	6.3	6.1	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.6
9 40	8.3	7.9	7.6	7.3	7.0	6.7	6.5	6.3	6.1	5.8	5.6	5.4	5.3	5.1	4.9	4.7
10 0	8.5	8.1	7.8	7.5	7.2	6.9	6.7	6.5	6.2	6.0	5.8	5.6	5.4	5.3	5.1	4.9
10 30	8.7	8.3	8.0	7.7	7.4	7.2	6.9	6.7	6.5	6.3	6.1	5.9	5.7	5.5	5.4	5.2
11 0	8.9	8.6	8.2	7.9	7.6	7.4	7.2	6.9	6.7	6.5	6.3	6.1	5.9	5.7	5.6	5.4
11 30	9.1	8.8	8.4	8.1	7.8	7.6	7.4	7.1	6.9	6.7	6.5	6.3	6.1	5.9	5.8	5.6
12 0	9.3	9.0	8.7	8.3	8.0	7.8	7.6	7.3	7.1	6.9	6.7	6.5	6.3	6.2	6.0	5 8
13 0	9.6	9.3	9.0	8.7	8.4	8.1	7.9	7.7	7.4	7.2	7.0	6.8	6.6	6.5	6.3	6.1
14 0	9.9	9.6	9.2	8.9	8.7	8.4	8.2	7.9	7.7	7.5	7.3	7.1	6.9	6.8	6.6	6.4
15 0	10.2	9.8	9.5	9.2	8.9	8.7	8.4	8.2	8.0	7.8	7.6	7.4	7.2	7.0	6.9	6.7
16 0	10.4	10.1	9.7	9.4	9.1	8.9	8.7	8.4	8.2	8.0	7.8	7.6	7.4	7.2	7.1	6.9
17 0	10.6	10.3	9.9	9.6	9.3	9.1	8.9	8.6	8.3	8.2	8.0	7.8	7.6	7.4	7.3	7.1
18 0	10.8	10.4	10.1	9.8	9.5	9.3	9.0	8.8	8.6	8.4	8.2	8.0	7.8	7.6	7.5	7.3
19 0	11.0	10.6	10.3	10.0	9.7	9.4	9.2	9.0	8.8	8.5	8.3	8.1	8.0	7.8	7.6	7.4
20 0	11.1	10.7	10.4	10.1	9.8	9.6	9 3	9.1	8.9	8.7	8.5	8.2	8.1	7.9	7.7	7.6
21 0	11.2	10.9	10.5	10.2	10.0	9.7	9.5	9.2	9.0	8.8	8.6	8.4	8.2	8.1	7.9	7.7
22 0	11.4	11.0	10.7	10.4	10.1	9.8	9.6	9.4	9.1	8.9	8.7	8.5	8.3	8.2	8 0	7.8
23 0	11.5	11 1	10.8	10.5	10.2	9.9	9.7	9.5	9.2	9.0	8.8	8.6	8.4	8.3	8.1	7.9
24 0	11.6	11.2	10.9	10.6	10.3	10.0	9.8	9.6	9.3	9.1	8.9	8.7	8.5	8.4	8.2	8.0
25 0	11.7	11.3	11.0	10.7	10.4	10.1	9.9	9.7	9.4	9.2	9.0	8.8	8.6	8.5	8.3	8.1
26 0	11.7	11.4	11.0	10.7	10.5	10.2	10.0	9.7	9.5	9.3	9.1	8.9	8.7	8.6	8.4	8.2
27 0	11.8	11.5	11.1	10.8	10.5	10.3	10.1	9.8	9.6	9.4	9.2	9.0	8.8	8.6	8.5	8.3
28 0	11.9	11.6	11.2	10.9	10.6	10.4	10.2	9.9	9.7	9.5	9.3	9.1	8.9	8.7	8.5	8.4
30 0	12.0	11.7	11.3	11.0	10.8	10.5	10.3	10.0	9.8	9.6	9.4	9.2	9.0	8.9	8.7	8.5
32 0	12.2	11.8	11.5	11.2	10.9	10.6	10.4	10.2	9.9	9.7	9.5	9.3	9.1	9.0	8.8	8.6
34 0	12.3	11.9	11.6	11.3	11.0	10.7	10.5	10.3	10.1	9.9	9.6	9.4	9.2	9.1	8.9	8.7
36 0	12.4	12.0	11.7	11.4	11.1	10.8	10.6	10.4	10.2	9.9	9.7	9.5	9.3	9.2	9.0	8.8
38 0	12.5	12.1	11.8	11.5	11.2	10.9	10.7	10.5	10.2	10.0	9.8	9.6	9.4	9.3	9.1	8.9
40 0	12.5	12.2	11.8	11.5	11.3	11.0	10.8	10.5	10.3	10.1	9.9	9.7	9.5	9.4	9.2	9.0
42 0	12.6	12.2	11.9	11.6	11.3	11.1	10.8	10.6	10.4	10.2	10.0	9.8	9.6	9.4	9.3	9.1
44 0	12.7	12.3	12.0	11.7	11.4	11.1	10.9	10.7	10.5	10.2	10.1	9.8	9.7	9.5	9.3	9.1
46 0	12.7	12.4	12.0	11.7	11.5	11.2	11.0	10.7	10.5	10.3	10.2	9.9	9.7	9.6	9.4	9.2
48 0	12.8	12.4	12.1	11.8	11.5	11.3	11.0	10.8	10.6	10.4	10.2	10.0	9.8	9.6	9.5	9.3
50 0	12.8	12.5	12.2	11.9	11.6	11.3	11.1	10.9	10.6	10.4	10.3	10.0	9.8	9.7	9.5	9.3
52 0	12.9	12.5	12.2	11.9	11.6	11.4	11.1	10.9	10.7	10.5	10.3	10.1	9.9	9.7	9.6	9.4
54 0	13.0	12.6	12.3	12.0	11.7	11.4	11.2	11.0	10.7	10.5	10.3	10.1	9.9	9.8	9.6	9.4
56 0	13.0	12.6	12.3	12.0	11.7	11.5	11.2	11.0	10.8	10.6	10.4	10.2	10.0	9.8	9.7	9.5
58 0	13.0	12.7	12.3	12.0	11.7	11.5	11.3	11.0	10.8	10.6	10.4	10.2	10.0	9.9	9.7	9.5
60 0	13.1	12.7	12.4	12.1	11.8	11.6	11.3	11.1	10.9	10.6	10.4	10.2	10.1	9.9	9.7	9.5
62 0	13.1	12.8	12.4	12.1	11.8	11.6	11.4	11.1	10.9	10.7	10.5	10.3	10.1	9.9	9.8	9.6
64 0	13.2	12.8	12.5	12.2	11.9	11.6	11.4	11.2	10.9	10.7	10.5	10.3	10.1	10.0	9.8	9.6
66 0	13.2	12.8	12.5	12.2	11.9	11.7	11.4	11.2	11.0	10.8	10.6	10.4	10.2	10.0	9.8	9.7
70 0	13.3	12.9	12.6	12.3	12.0	11.8	11.5	11.3	11.0	10.8	10.6	10.4	10.2	10.1	9.9	9.7
80 0	13.4	13.1	12.7	12.4	12.1	11.9	11.7	11.4	11.2	11.0	10.8	10.6	10.4	10.2	10.1	9.9
90 0	13.6	13.2	12.9	12 6	12.3	12.0	11.8	11.6	11.3	11.1	10.9	10.7	10.5	10.4	10.2	10.0

Month,	Jan.	Feb.	Mar.	April,	May,	June,	July,	Aug.	Sept.	Oct.	Nov.	Dec.
Correction,	+0′.3	+0′.2	+0′.1	0′.0	−0′.2	−0′.2	−0′.3	−0′.2	−0′.1	+0′.1	+0 .2	+0′.3

TABLE X.

SUN'S DECLINATION for the Years 1828, 1832, 1836, 1840, &c.

Days	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Days
	South	South	South	North	North	North	North	North	North	South	South	South	
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	
1	23 4	17 18	7 28	4 39	15 9	22 6	23 7	17 59	8 13	3 17	14 32	21 52	1
2	22 59	17 1	7 5	5 2	15 27	22 14	23 3	17 44	7 51	3 40	14 51	22 1	2
3	22 54	16 43	6 42	5 25	15 45	22 21	22 58	17 29	7 29	4 3	15 10	22 10	3
4	22 48	16 26	6 19	5 48	16 2	22 28	22 53	17 13	7 7	4 26	15 28	22 18	4
5	22 42	16 8	5 56	6 10	16 19	22 35	22 47	16 56	6 45	4 50	15 47	22 26	5
6	22 35	15 50	5 33	6 33	16 36	22 41	22 42	16 40	6 22	5 13	16 5	22 33	6
7	22 28	15 31	5 10	6 56	16 53	22 47	22 35	16 23	6 0	5 36	16 22	22 40	7
8	22 21	15 13	4 46	7 18	17 9	22 53	22 29	16 6	5 37	5 59	16 40	22 46	8
9	22 13	14 54	4 23	7 41	17 25	22 58	22 21	15 49	5 15	6 22	16 57	22 52	9
10	22 4	14 34	3 59	8 3	17 41	23 3	22 14	15 32	4 52	6 44	17 14	22 58	10
11	21 55	14 15	3 36	8 25	17 57	23 7	22 6	15 14	4 29	7 7	17 31	23 3	11
12	21 46	13 55	3 12	8 47	18 12	23 11	21 58	14 56	4 6	7 30	17 47	23 7	12
13	21 36	13 35	2 49	9 8	18 27	23 14	21 49	14 38	3 43	7 52	18 3	23 11	13
14	21 26	13 15	2 25	9 30	18 41	23 17	21 40	14 19	3 20	8 15	18 19	23 15	14
15	21 15	12 55	2 1	9 52	18 56	23 20	21 31	14 1	2 57	8 37	18 34	23 18	15
16	21 4	12 34	1 38	10 13	19 10	23 22	21 21	13 42	2 34	8 59	18 50	23 21	16
17	20 53	12 13	1 14	10 34	19 23	23 24	21 11	13 22	2 11	9 21	19 4	23 23	17
18	20 41	11 52	0 50	10 55	19 36	23 26	21 1	13 3	1 47	9 43	19 19	23 25	18
19	20 29	11 31	0 26	11 16	19 49	23 27	20 50	12 44	1 24	10 5	19 33	23 26	19
20	20 16	11 10	0 3S	11 36	20 2	23 27	20 39	12 24	1 1	10 26	19 46	23 27	20
21	20 4	10 48	0 21N	11 57	20 14	23 28	20 27	12 4	0 37	10 48	20 0	23 28	21
22	19 50	10 27	0 45	12 17	20 26	23 27	20 16	11 44	0 14N	11 9	20 13	23 27	22
23	19 36	10 5	1 8	12 37	20 38	23 27	20 3	11 23	0 9S	11 30	20 25	23 27	23
24	19 22	9 43	1 32	12 57	20 49	23 26	19 51	11 3	0 33	11 51	20 38	23 26	24
25	19 8	9 21	1 55	13 16	21 0	23 24	19 38	10 42	0 56	12 12	20 49	23 24	25
26	18 53	8 58	2 19	13 36	21 10	23 22	19 25	10 21	1 20	12 32	21 1	23 22	26
27	18 38	8 36	2 42	13 55	21 21	23 20	19 12	10 0	1 43	12 53	21 12	23 20	27
28	18 23	8 14	3 6	14 14	21 30	23 18	18 58	9 39	2 6	13 13	21 23	23 17	28
29	18 7	7 51	3 29	14 33	21 40	23 14	18 44	9 18	2 30	13 33	21 33	23 14	29
30	17 51		3 52	14 51	21 49	23 11	18 29	8 57	2 53	13 53	21 43	23 10	30
31	17 34		4 16		21 57		18 14	8 35		14 12		23 5	31

TABLE XI. TO CORRECT THE SUN'S DECLINATION.

When Declin. } add in W. Long. }
is increasing, } sub. in E. Long. }

When Declin. } sub. in W. Long. }
is decreasing, } add in E. Long. }

Long.	SUN'S DECLINATION.																									Long.
	° 0	° 1	° 2	° 3	° 4	° 5	° 6	° 7	° 8	° 9	° 10	° 11	° 12	° 13	° 14	° 15	° 16	° 17	° 18	° 19	° 20	° 21	° 22	° 23	° 23½	
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	°
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	10
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	20
30	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	0	30
40	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	0	40
50	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	1	1	1	0	50
60	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3	2	2	2	1	1	0	60
70	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	2	2	2	1	0	70
80	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	3	3	3	2	2	1	0	80
90	6	6	6	6	6	6	6	6	6	6	5	5	5	5	5	5	4	4	4	4	3	3	2	1	0	90
100	7	7	6	6	6	6	6	6	6	6	6	6	6	6	5	5	5	5	4	4	4	3	2	1	0	100
110	7	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	5	5	5	4	4	3	3	1	0	110
120	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6	6	6	6	5	5	4	4	3	2	0	120
130	9	8	8	8	8	8	8	8	8	8	8	8	7	7	7	7	6	6	6	5	5	4	3	2	0	130
140	9	9	9	9	9	9	9	9	9	9	8	8	8	8	7	7	7	6	6	6	5	4	3	2	0	140
150	10	10	10	10	10	10	10	9	9	9	9	9	9	8	8	8	7	7	6	6	5	5	4	2	0	150
160	10	10	10	10	10	10	10	10	10	10	10	9	9	9	9	8	8	7	7	6	6	5	4	2	0	160
170	11	11	11	11	11	11	11	10	10	10	10	10	10	9	9	9	8	8	7	7	6	5	4	2	0	170
180	12	12	12	12	12	12	11	11	11	11	11	11	10	10	10	9	9	8	8	7	6	5	4	2	0	180

TABLE X.

SUN S DECLINATION for the Years 1829, 1833, 1837, 1841, &c.

Days	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Days
	South	South	South	North	North	North	North	North	North	South	South	South	
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	
1	23 1	17 5	7 34	4 33	15 5	22 4	23 8	18 3	8 18	3 11	14 27	21 50	1
2	22 55	16 48	7 11	4 56	15 23	22 12	23 4	17 48	7 57	3 34	14 46	21 59	2
3	22 50	16 30	6 48	5 19	15 41	22 19	22 59	17 32	7 35	3 58	15 5	22 8	3
4	22 44	16 12	6 25	5 42	15 58	22 27	22 54	17 17	7 12	4 21	15 24	22 16	4
5	22 37	15 54	6 2	6 5	16 15	22 33	22 49	17 0	6 50	4 44	15 42	22 24	5
6	22 30	15 36	5 38	6 28	16 32	22 40	22 43	16 44	6 28	5 7	16 0	22 31	6
7	22 22	15 17	5 15	6 50	16 49	22 46	22 37	16 27	6 5	5 30	16 18	22 38	7
8	22 15	14 58	4 52	7 13	17 5	22 51	22 30	16 10	5 43	5 53	16 36	22 45	8
9	22 6	14 39	4 28	7 35	17 22	22 57	22 23	15 53	5 20	6 16	16 53	22 51	9
10	21 57	14 19	4 5	7 57	17 37	23 1	22 16	15 36	4 58	6 39	17 10	22 56	10
11	21 48	14 0	3 41	8 20	17 53	23 6	22 8	15 18	4 35	7 1	17 27	23 1	11
12	21 38	13 40	3 18	8 41	18 8	23 10	22 0	15 0	4 12	7 24	17 43	23 6	12
13	21 28	13 20	2 54	9 3	18 23	23 13	21 51	14 42	3 49	7 47	17 59	23 10	13
14	21 18	13 0	2 31	9 25	18 38	23 17	21 43	14 24	3 26	8 9	18 15	23 14	14
15	21 7	12 39	2 7	9 46	18 52	23 19	21 33	14 5	3 3	8 31	18 31	23 17	15
16	20 56	12 18	1 43	10 8	19 6	23 22	21 24	13 46	2 40	8 54	18 46	23 20	16
17	20 44	11 57	1 20	10 29	19 20	23 24	21 14	13 27	2 16	9 16	19 1	23 23	17
18	20 32	11 36	0 56	10 50	19 33	23 25	21 3	13 8	1 53	9 38	19 15	23 25	18
19	20 19	11 15	0 32	11 11	19 46	23 27	20 53	12 48	1 30	9 59	19 29	23 26	19
20	20 7	10 54	0 8 S	11 31	19 59	23 27	20 42	12 29	1 7	10 21	19 43	23 27	20
21	19 53	10 32	0 15 N	11 52	20 11	23 28	20 30	12 9	0 43	10 42	19 56	23 27	21
22	19 40	10 10	0 39	12 12	20 23	23 27	20 19	11 49	0 20N	11 4	20 10	23 28	22
23	19 26	9 48	1 2	12 32	20 35	23 27	20 6	11 29	0 4 S	11 25	20 22	23 27	23
24	19 12	9 26	1 26	12 52	20 46	23 26	19 54	11 8	0 27	11 46	20 35	23 26	24
25	18 57	9 4	1 50	13 12	20 57	23 25	19 41	10 47	0 50	12 7	20 47	23 25	25
26	18 42	8 42	2 13	13 31	21 8	23 23	19 28	10 27	1 14	12 27	20 58	23 23	26
27	18 26	8 19	2 37	13 50	21 18	23 21	19 15	10 6	1 37	12 48	21 9	23 21	27
28	18 11	7 56	3 0	14 9	21 28	23 18	19 1	9 44	2 1	13 8	21 20	23 18	28
29	17 55		3 23	14 28	21 37	23 15	18 47	9 23	2 24	13 28	21 30	23 14	29
30	17 38		3 47	14 46	21 47	23 12	18 33	9 2	2 48	13 48	21 40	23 11	30
31	17 22		4 10		21 55		18 18	8 40		14 8		23 7	31

TABLE XI. TO CORRECT THE SUN'S DECLINATION.

When Declin. is increasing, add in W. Long. sub. in E. Long.

When Declin. is decreasing, sub. in W. Long. add in E. Long.

Long.	SUN'S DECLINATION.																									Long.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23½	
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	°
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	10
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	20
30	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	0	30
40	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	0	40
50	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	1	1	1	0	50
60	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3	2	2	2	1	1	0	60
70	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	2	2	2	1	0	70
80	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	3	3	3	2	2	1	0	80
90	6	6	6	6	6	6	6	6	6	6	5	5	5	5	5	5	4	4	4	4	3	3	2	1	0	90
100	7	7	6	6	6	6	6	6	6	6	6	6	6	6	5	5	5	5	4	4	4	3	2	1	0	100
110	7	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	5	5	5	4	4	3	3	1	0	110
120	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6	6	6	6	5	5	4	4	3	2	0	120
130	9	8	8	8	8	8	8	8	8	8	8	8	7	7	7	7	6	6	6	5	5	4	3	2	0	130
140	9	9	9	9	9	9	9	9	9	9	8	8	8	8	7	7	7	6	6	6	5	4	3	2	0	140
150	10	10	10	10	10	10	10	9	9	9	9	9	9	8	8	8	7	7	6	6	5	5	4	2	0	150
160	10	10	10	10	10	10	10	10	10	10	10	9	9	9	9	8	8	7	7	6	6	5	4	2	0	160
170	11	11	11	11	11	11	11	10	10	10	10	10	10	9	9	9	8	8	7	7	6	5	4	2	0	170
180	12	12	12	12	12	12	11	11	11	11	11	11	10	10	10	9	9	8	8	7	6	5	4	2	0	180

TABLE X.

SUN'S DECLINATION for the Years 1830, 1834, 1838, 1842, &c.

Days	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Days
	South	South	South	North	North	North	North	North	North	South	South	South	
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	
1	23 2	17 9	7 39	4 28	15 0	22 2	23 9	18 7	8 24	3 5	14 22	21 47	1
2	22 57	16 52	7 16	4 51	15 18	22 10	23 5	17 52	8 2	3 29	14 42	21 57	2
3	22 51	16 34	6 53	5 14	15 36	22 18	23 0	17 36	7 40	3 52	15 0	22 6	3
4	22 45	16 17	6 30	5 37	15 54	22 25	22 55	17 20	7 18	4 15	15 19	22 14	4
5	22 39	15 58	6 7	5 59	16 11	22 32	22 50	17 4	6 56	4 38	15 38	22 22	5
6	22 32	15 40	5 44	6 22	16 28	22 38	22 44	16 48	6 33	5 1	15 56	22 29	6
7	22 24	15 22	5 21	6 45	16 45	22 44	22 38	16 31	6 11	5 25	16 14	22 36	7
8	22 17	15 3	4 58	7 7	17 1	22 50	22 32	16 15	5 48	5 48	16 31	22 43	8
9	22 8	14 44	4 34	7 30	17 18	22 55	22 25	15 57	5 26	6 10	16 49	22 49	9
10	22 0	14 24	4 11	7 52	17 34	23 0	22 18	15 40	5 3	6 33	17 6	22 55	10
11	21 50	14 5	3 47	8 14	17 49	23 5	22 10	15 22	4 40	6 56	17 23	23 0	11
12	21 41	13 45	3 24	8 36	18 5	23 9	22 2	15 5	4 17	7 19	17 39	23 5	12
13	21 31	13 25	3 0	8 58	18 20	23 13	21 54	14 46	3 54	7 41	17 55	23 9	13
14	21 21	13 5	2 36	9 20	18 34	23 16	21 45	14 28	3 31	8 4	18 11	23 13	14
15	21 10	12 44	2 13	9 41	18 49	23 19	21 36	14 10	3 8	8 26	18 27	23 17	15
16	20 59	12 24	1 49	10 2	19 3	23 21	21 26	13 51	2 45	8 48	18 42	23 20	16
17	20 47	12 3	1 25	10 24	19 17	23 23	21 16	13 32	2 22	9 10	18 57	23 22	17
18	20 35	11 42	1 2	10 45	19 30	23 25	21 6	13 12	1 59	9 32	19 12	23 24	18
19	20 23	11 20	0 38	11 6	19 43	23 26	20 55	12 53	1 35	9 54	19 26	23 26	19
20	20 10	10 59	0 14 S	11 26	19 56	23 27	20 44	12 33	1 12	10 16	19 40	23 27	20
21	19 57	10 37	0 9 N	11 47	20 8	23 28	20 33	12 14	0 49	10 37	19 53	23 27	21
22	19 43	10 16	0 33	12 7	20 20	23 27	20 21	11 53	0 25	10 59	20 6	23 28	22
23	19 29	9 54	0 57	12 27	20 32	23 27	20 9	11 33	0 2 N	11 20	20 19	23 27	23
24	19 15	9 32	1 20	12 47	20 44	23 26	19 57	11 13	0 22 S	11 41	20 32	23 26	24
25	19 0	9 9	1 44	13 7	20 55	23 25	19 44	10 52	0 45	12 2	20 44	23 25	25
26	18 46	8 47	2 7	13 26	21 5	23 23	19 31	10 31	1 8	12 23	20 55	23 23	26
27	18 30	8 24	2 31	13 46	21 10	23 21	19 18	10 11	1 32	12 43	21 7	23 21	27
28	18 15	8 2	2 54	14 5	21 26	23 19	19 4	9 49	1 55	13 3	21 17	23 18	28
29	17 59		3 18	14 23	21 35	23 16	18 50	9 28	2 19	13 23	21 28	23 15	29
30	17 42		3 41	14 42	21 44	23 13	18 36	9 7	2 42	13 43	21 38	23 12	30
31	17 26		4 4		21 53		18 22	8 45		14 3		23 8	31

TABLE XI.*

To correct the Sun's Declination for the changes in periods of Four Years.

Periods of Years.	MONTHS.															Periods of Years.
	JANUARY.					FEBRUARY.					MARCH.					
	Days.					Days.					Days.					
	1	7	13	19	25	1	7	13	19	25	1	7	13	19	25	
	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub	sub	add.	
	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	
4	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	4
8	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	8
12	0	1	1	1	1	1	2	2	2	2	2	2	2	2	2	12
16	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	16
20	1	1	1	2	2	2	3	3	3	3	3	3	3	4	4	20
	APRIL.					MAY.					JUNE.					
	Days.					Days.					Days.					
	1	7	13	19	25	1	7	13	19	25	1	7	13	19	25	
	add.	add.	add.	add.	add.	add.	add.	add.	add.	add.	add	add.	add.			
	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	
4	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	4
8	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	8
12	2	2	2	2	2	2	2	1	1	1	1	1	0	0	0	12
16	3	3	3	3	2	2	2	2	1	1	1	1	0	0	0	16
20	3	3	3	3	3	3	3	2	2	2	1	1	1	0	0	20

TABLE X.

SUN'S DECLINATION for the Years 1831, 1835, 1839, 1843, &c.

Days	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Days
	South	South	South	North	North	North	North	North	North	South	South	South	
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	
1	23 3	17 13	7 45	4 22	14 56	22 0	23 10	18 10	8 29	3 0	14 18	21 45	1
2	22 58	16 56	7 22	4 45	15 14	22 8	23 6	17 55	8 7	3 23	14 37	21 55	2
3	22 53	16 39	6 59	5 8	15 32	22 16	23 2	17 40	7 45	3 46	14 56	22 4	3
4	22 47	16 21	6 36	5 31	15 50	22 23	22 57	17 24	7 23	4 10	15 15	22 12	4
5	22 40	16 3	6 13	5 54	16 7	22 30	22 52	17 8	7 1	4 33	15 33	22 20	5
6	22 34	15 45	5 50	6 17	16 24	22 37	22 46	16 52	6 39	4 56	15 52	22 28	6
7	22 26	15 26	5 27	6 39	16 41	22 43	22 40	16 35	6 16	5 19	16 10	22 35	7
8	22 19	15 7	5 3	7 2	16 58	22 49	22 33	16 19	5 54	5 42	16 27	22 42	8
9	22 10	14 48	4 40	7 24	17 14	22 54	22 27	16 2	5 31	6 5	16 45	22 48	9
10	22 2	14 29	4 16	7 46	17 30	22 59	22 20	15 44	5 8	6 28	17 2	22 54	10
11	21 53	14 10	3 53	8 9	17 46	23 4	22 12	15 27	4 46	6 51	17 19	22 59	11
12	21 43	13 50	3 29	8 31	18 1	23 8	22 4	15 9	4 23	7 13	17 35	23 4	12
13	21 33	13 30	3 6	8 53	18 16	23 12	21 56	14 51	4 0	7 36	17 52	23 8	13
14	21 23	13 10	2 42	9 14	18 31	23 15	21 47	14 33	3 37	7 58	18 8	23 12	14
15	21 13	12 49	2 19	9 36	18 45	23 18	21 38	14 14	3 14	8 21	18 23	23 16	15
16	21 1	12 29	1 55	9 57	19 00	23 21	21 28	13 55	2 51	8 43	18 39	23 19	16
17	20 50	12 8	1 31	10 19	19 13	23 23	21 19	13 36	2 28	9 5	18 54	23 22	17
18	20 38	11 47	1 7	10 40	19 27	23 25	21 9	13 17	2 4	9 27	19 8	23 24	18
19	20 26	11 26	0 44	11 1	19 40	23 26	20 58	12 58	1 41	9 49	19 23	23 25	19
20	20 13	11 4	0 20 S	11 22	19 53	23 27	20 47	12 38	1 18	10 11	19 37	23 27	20
21	20 0	10 43	0 4 N	11 42	20 5	23 28	20 36	12 18	0 54	10 32	19 50	23 27	21
22	19 47	10 21	0 27	12 2	20 18	23 28	20 24	11 58	0 31	10 54	20 3	23 28	22
23	19 33	9 59	0 51	12 22	20 30	23 27	20 12	11 38	0 7 N	11 15	20 16	23 27	23
24	19 19	9 37	1 15	12 42	20 41	23 27	20 0	11 18	0 16 S	11 36	20 29	23 27	24
25	19 4	9 15	1 38	13 2	20 52	23 26	19 47	10 57	0 39	11 57	20 41	23 26	25
26	18 49	8 52	2 2	13 22	21 3	23 24	19 35	10 36	1 3	12 18	20 53	23 24	26
27	18 34	8 30	2 25	13 41	21 13	23 22	19 21	10 16	1 26	12 38	21 4	23 22	27
28	18 19	8 7	2 49	14 0	21 23	23 20	19 8	9 55	1 50	12 59	21 15	23 19	28
29	18 3		3 12	14 19	21 33	23 17	18 54	9 33	2 13	13 19	21 26	23 16	29
30	17 47		3 36	14 38	21 42	23 14	18 40	9 12	2 36	13 39	21 36	23 13	30
31	17 30		3 59		21 51		18 25	8 50		13 58		23 9	31

TABLE XI.*

To correct the Sun's Declination for the changes in periods of Four Years.

Periods of Years.	MONTHS.															Periods of Years.
	JULY.					AUGUST.					SEPTEMBER.					
	Days.					Days.					Days.					
	1	7	13	19	25	1	7	13	19	25	1	7	13	19	25	
	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub	sub	add.	
	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	
4	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	4
8	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	8
12	0	1	1	1	1	1	2	2	2	2	2	2	2	2	2	12
16	0	1	1	1	2	2	2	2	2	3	3	3	3	3	3	16
20	1	1	1	2	2	2	2	3	3	3	3	3	3	4	4	20
	OCTOBER.					NOVEMBER.					DECEMBER.					
	Days.					Days.					Days.					
	1	7	13	19	25	1	7	13	19	25	1	7	13	19	25	
	add.	add.	add.	add.	add.	add.	add.	add.	add.	add.	add.	add.	add.			
	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	
4	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	4
8	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	8
12	2	2	2	2	2	2	2	1	1	1	1	1	0	0	0	12
16	3	3	3	3	2	2	2	2	2	1	1	1	0	0	0	16
20	3	3	3	3	3	3	3	2	2	2	2	1	1	0	0	20

TABLE XII.

AMPLITUDES.

DECLINATION.

Lat.	1°		2°		3°		4°		5°		6°		7°		8°		9°		10°		11°		12°		13°		14°	
°	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′
1	1	0	2	0	3	0	4	0	5	0	6	0	7	0	8	0	9	0	10	0	11	0	12	0	13	0	14	0
3	1	0	2	0	3	0	4	0	5	0	6	0	7	1	8	1	9	1	10	1	11	1	12	1	13	1	14	1
5	1	0	2	0	3	1	4	1	5	1	6	1	7	2	8	2	9	2	10	2	11	3	12	3	13	3	14	3
7	1	0	2	1	3	1	4	2	5	2	6	3	7	3	8	4	9	4	10	5	11	5	12	5	13	6	14	6
9	1	1	2	1	3	2	4	3	5	4	6	5	7	5	8	6	9	7	10	8	11	8	12	9	13	10	14	11
11	1	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	9	10	10	11	11	13	12	14	13	15	14	16
13	1	2	2	3	3	5	4	6	5	8	6	10	7	11	8	13	9	14	10	16	11	18	12	19	13	21	14	23
14	1	2	2	4	3	6	4	7	5	9	6	11	7	13	8	15	9	17	10	19	11	20	12	22	13	24	14	26
15	1	2	2	4	3	6	4	8	5	11	6	13	7	15	8	17	9	19	10	21	11	24	12	26	13	28	14	30
16	1	2	2	5	3	7	4	10	5	12	6	15	7	17	8	19	9	22	10	24	11	27	12	29	13	32	14	35
17	1	3	2	5	3	8	4	11	5	14	6	17	7	19	8	22	9	25	10	28	11	31	12	33	13	36	14	39
18	1	3	2	6	3	9	4	12	5	15	6	19	7	22	8	25	9	28	10	31	11	34	12	38	13	41	14	44
19	1	3	2	7	3	10	4	14	5	17	6	21	7	24	8	28	9	31	10	35	11	39	12	42	13	46	14	49
20	1	4	2	8	3	12	4	15	5	19	6	23	7	27	8	31	9	35	10	39	11	43	12	47	13	51	14	55
21	1	4	2	9	3	13	4	17	5	21	6	26	7	30	8	34	9	39	10	43	11	48	12	52	13	57	15	1
22	1	5	2	9	3	14	4	19	5	24	6	28	7	33	8	38	9	43	10	48	11	53	12	57	14	2	15	7
23	1	5	2	10	3	16	4	21	5	26	6	31	7	36	8	42	9	47	10	52	11	58	13	3	14	9	15	14
24	1	6	2	11	3	17	4	23	5	28	6	34	7	40	8	46	9	52	10	57	12	3	13	9	14	15	15	21
25	1	6	2	12	3	19	4	25	5	31	6	37	7	44	8	50	9	56	11	3	12	9	13	16	14	22	15	29
26	1	7	2	14	3	20	4	27	5	34	6	41	7	48	8	54	10	1	11	8	12	15	13	22	14	30	15	37
27	1	7	2	15	3	22	4	29	5	37	6	44	7	52	8	59	10	7	11	14	12	22	13	30	14	37	15	45
28	1	8	2	16	3	24	4	32	5	40	6	48	7	56	9	4	10	12	11	21	12	29	13	37	14	46	15	54
29	1	9	2	17	3	26	4	34	5	43	6	52	8	1	9	9	10	18	11	27	12	36	13	45	14	54	16	3
30	1	9	2	19	3	28	4	37	5	47	6	56	8	5	9	15	10	24	11	34	12	44	13	53	15	3	16	13
31	1	10	2	20	3	30	4	40	5	50	7	0	8	10	9	21	10	31	11	41	12	52	14	2	15	13	16	24
32	1	11	2	22	3	32	4	43	5	54	7	5	8	16	9	27	10	38	11	49	13	0	14	11	15	23	16	34
33	1	12	2	23	3	35	4	46	5	58	7	10	8	21	9	33	10	45	11	57	13	9	14	21	15	34	16	46
34	1	12	2	25	3	37	4	50	6	2	7	15	8	27	9	40	10	53	12	5	13	18	14	31	15	45	16	58
35	1	13	2	27	3	40	4	53	6	6	7	20	8	33	9	47	11	1	12	14	13	28	14	42	15	56	17	11
36	1	14	2	28	3	43	4	57	6	11	7	25	8	40	9	54	11	9	12	24	13	39	14	54	16	9	17	24
37	1	15	2	30	3	45	5	1	6	16	7	31	8	47	10	2	11	18	12	33	13	49	15	5	16	22	17	38
38	1	16	2	32	3	48	5	5	6	21	7	37	8	54	10	10	11	27	12	44	14	1	15	18	16	35	17	53
39	1	17	2	34	3	52	5	9	6	26	7	44	9	1	10	19	11	37	12	55	14	13	15	31	16	50	18	8
40	1	18	2	37	3	55	5	13	6	32	7	51	9	9	10	28	11	47	13	6	14	25	15	45	17	5	18	25
41	1	20	2	39	3	59	5	18	6	38	7	58	9	18	10	38	11	58	13	18	14	39	15	59	17	20	18	42
42	1	21	2	42	4	2	5	23	6	44	8	5	9	26	10	48	12	9	13	31	14	53	16	15	17	37	19	0
43	1	22	2	44	4	6	5	28	6	51	8	13	9	36	10	58	12	21	13	44	15	7	16	31	17	55	19	19
44	1	23	2	47	4	10	5	34	6	58	8	21	9	45	11	9	12	34	13	58	15	23	16	48	18	13	19	39
45	1	25	2	50	4	15	5	40	7	5	8	30	9	55	11	21	12	47	14	13	15	39	17	6	18	33	20	0
46	1	26	2	53	4	19	5	46	7	12	8	39	10	6	11	33	13	1	14	29	15	57	17	25	18	54	20	23
47	1	28	2	56	4	24	5	52	7	21	8	49	10	18	11	46	13	16	14	45	16	15	17	45	19	16	20	47
48	1	30	2	59	4	29	5	59	7	29	8	59	10	30	12	0	13	31	15	2	16	34	18	6	19	39	21	12
49	1	31	3	3	4	35	6	6	7	38	9	10	10	42	12	15	13	48	15	21	16	54	18	29	20	3	21	38
50	1	33	3	7	4	40	6	14	7	48	9	22	10	56	12	30	14	5	15	40	17	16	18	52	20	29	22	7
51	1	35	3	11	4	46	6	22	7	58	9	34	11	10	12	47	14	24	16	1	17	39	19	17	20	57	22	36
52	1	37	3	15	4	53	6	30	8	8	9	47	11	25	13	4	14	43	16	23	18	3	19	44	21	26	23	8
53	1	40	3	19	4	59	6	39	8	20	10	0	11	41	13	22	15	4	16	46	18	29	20	13	21	57	23	42
54	1	42	3	24	5	7	6	49	8	32	10	15	11	58	13	42	15	26	17	11	18	57	20	43	22	30	24	18
55	1	45	3	29	5	14	6	59	8	44	10	30	12	16	14	3	15	50	17	37	19	26	21	15	23	5	24	57
56	1	47	3	35	5	22	7	10	8	58	10	46	12	35	14	25	16	15	18	5	19	57	21	50	23	43	25	38
57	1	50	3	40	5	31	7	22	9	13	11	4	12	56	14	48	16	42	18	36	20	30	22	26	24	24	26	22
58	1	53	3	47	5	40	7	34	9	28	11	23	13	18	15	14	17	10	19	8	21	6	23	6	25	7	27	10
59	1	57	3	53	5	50	7	47	9	45	11	43	13	41	15	41	17	41	19	42	21	45	23	49	25	54	28	1
60	2	0	4	0	6	0	8	1	10	2	12	4	14	6	16	10	18	14	20	19	22	26	24	34	26	44	28	56
61	2	4	4	8	6	12	8	16	10	21	12	27	14	34	16	41	18	49	20	59	23	11	25	24	27	39	29	56
62	2	8	4	16	6	24	8	33	10	42	12	52	15	3	17	15	19	28	21	42	23	59	26	17	28	38	31	1
63	2	12	4	25	6	37	8	50	11	4	13	19	15	34	17	51	20	9	22	29	24	51	27	15	29	42	32	12
64	2	17	4	34	6	51	9	9	11	28	13	48	16	8	18	31	20	54	23	20	25	48	28	19	30	52	33	30
65	2	22	4	44	7	7	9	30	11	54	14	19	16	46	19	14	21	44	24	16	26	50	29	28	32	10	34	55
66	2	28	4	55	7	24	9	53	12	22	14	54	17	26	20	1	22	37	25	16	27	59	30	45	33	35	36	30

TABLE XII.

AMPLITUDES.

DECLINATION.

Lat.	15°		16°		17°		18°		19°		20°		21°		21½°		22°		22½°		23°		23½°	
°	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'
1	15	0	16	0	17	0	18	0	19	0	20	0	21	0	21	30	22	0	22	30	23	0	23	30
3	15	1	16	1	17	1	18	2	19	2	20	2	21	2	21	32	22	2	22	32	23	2	23	32
5	15	4	16	4	17	4	18	4	19	5	20	5	21	5	21	35	22	5	22	35	23	6	23	36
7	15	7	16	7	17	8	18	8	19	9	20	9	21	10	21	40	22	10	22	41	23	11	23	41
9	15	11	16	12	17	13	18	14	19	15	20	16	21	16	21	47	22	17	22	48	23	18	23	49
11	15	17	16	18	17	20	18	21	19	22	20	23	21	25	21	55	22	26	22	57	23	27	23	58
13	15	24	16	26	17	28	18	29	19	31	20	33	21	35	22	6	22	37	23	8	23	38	24	9
14	15	28	16	30	17	32	18	34	19	36	20	38	21	40	22	11	22	43	23	14	23	45	24	16
15	15	33	16	35	17	37	18	39	19	42	20	44	21	47	22	18	22	49	23	20	23	52	24	23
16	15	37	16	40	17	42	18	45	19	48	20	51	21	53	22	25	22	56	23	28	23	59	24	30
17	15	42	16	45	17	48	18	51	19	54	20	57	22	1	22	32	23	4	23	35	24	7	24	39
18	15	47	16	51	17	54	18	58	20	1	21	5	22	8	22	40	23	12	23	44	24	15	24	47
19	15	53	16	57	18	1	19	5	20	8	21	12	22	16	22	49	23	20	23	52	24	25	24	57
20	15	59	17	3	18	8	19	12	20	16	21	21	22	25	22	57	23	30	24	2	24	34	25	7
21	16	6	17	10	18	15	19	20	20	25	21	29	22	34	23	7	23	39	24	12	24	45	25	17
22	16	13	17	18	18	23	19	28	20	33	21	39	22	44	23	17	23	50	24	23	24	55	25	28
23	16	20	17	25	18	31	19	37	20	43	21	49	22	55	23	28	24	1	24	34	25	7	25	40
24	16	27	17	34	18	40	19	46	20	53	21	59	23	6	23	39	24	13	24	46	25	19	25	53
25	16	36	17	42	18	49	19	56	21	3	22	10	23	18	23	51	24	25	24	59	25	32	26	6
26	16	44	17	52	18	59	20	7	21	14	22	22	23	30	24	4	24	38	25	12	25	46	26	20
27	16	53	18	1	19	9	20	18	21	26	22	34	23	43	24	17	24	52	25	26	26	1	26	35
28	17	3	18	11	19	20	20	29	21	38	22	47	23	57	24	31	25	6	25	41	26	16	26	51
29	17	13	18	22	19	32	20	41	21	51	23	1	24	11	24	46	25	22	25	57	26	32	27	7
30	17	23	18	34	19	44	20	54	22	5	23	16	24	27	25	2	25	38	26	13	26	49	27	25
31	17	34	18	45	19	57	21	8	22	19	23	31	24	43	25	19	25	55	26	31	27	7	27	43
32	17	46	18	58	20	10	21	22	22	35	23	47	25	0	25	36	26	13	26	49	27	26	28	3
33	17	59	19	11	20	24	21	37	22	51	24	4	25	18	25	55	26	32	27	9	27	46	28	23
34	18	11	19	25	20	39	21	53	23	7	24	22	25	37	26	14	26	52	27	29	28	7	28	45
35	18	25	19	40	20	55	22	10	23	25	24	41	25	57	26	35	27	13	27	51	28	29	29	8
36	18	39	19	55	21	11	22	27	23	44	25	1	26	18	26	56	27	35	28	14	28	53	29	32
37	18	55	20	11	21	28	22	46	24	3	25	21	26	40	27	19	27	58	28	38	29	17	29	57
38	19	10	20	28	21	47	23	5	24	24	25	43	27	3	27	43	28	23	29	3	29	44	30	24
39	19	27	20	46	22	6	23	26	24	46	26	7	27	28	28	8	28	49	29	30	30	11	30	52
40	19	45	21	5	22	26	23	47	25	9	26	31	27	54	28	35	29	17	29	58	30	40	31	22
41	20	3	21	25	22	48	24	10	25	33	26	57	28	21	29	3	29	46	30	28	31	11	31	54
42	20	23	21	46	23	10	24	34	25	59	27	24	28	50	29	33	30	16	31	0	31	43	32	27
43	20	44	22	8	23	34	25	00	26	26	27	53	29	20	30	5	30	49	31	33	32	18	33	2
44	21	5	22	32	23	59	25	26	26	55	28	23	29	53	30	38	31	23	32	8	32	54	33	39
45	21	28	22	57	24	25	25	55	27	25	28	56	30	27	31	13	31	59	32	46	33	33	34	20
46	21	53	23	23	24	53	26	25	27	57	29	30	31	3	31	51	32	38	33	26	34	14	35	2
47	22	18	23	50	25	23	26	57	28	31	30	6	31	42	32	30	33	19	34	8	34	57	35	47
48	22	45	24	20	25	55	27	30	29	7	30	44	32	23	33	13	34	3	34	53	35	44	36	35
49	23	14	24	51	26	28	28	6	29	45	31	25	33	7	33	58	34	49	35	41	36	33	37	25
50	23	45	25	24	27	3	28	44	30	26	32	9	33	53	34	46	35	39	36	32	37	26	38	20
51	24	17	25	59	27	41	29	25	31	9	32	55	34	43	35	37	36	32	37	27	38	23	39	19
52	24	52	26	36	28	21	30	8	31	56	33	45	35	36	36	32	37	29	38	26	39	24	40	22
53	25	28	27	16	29	4	30	54	32	45	34	38	36	33	37	31	38	30	39	29	40	29	41	30
54	26	7	27	58	29	50	31	43	33	38	35	35	37	34	38	34	39	36	40	37	41	40	42	43
55	26	49	28	43	30	39	32	36	34	35	36	36	38	40	39	43	40	47	41	51	42	56	44	3
56	27	34	29	32	31	31	33	33	35	36	37	42	39	51	40	57	42	4	43	11	44	20	45	29
57	28	22	30	24	32	28	34	34	36	43	38	54	41	9	42	18	43	27	44	38	45	50	47	4
58	29	14	31	21	33	29	35	40	37	54	40	12	42	33	43	45	44	59	46	14	47	30	48	48
59	30	10	32	21	34	35	36	52	39	12	41	37	44	6	45	22	46	40	47	59	49	21	50	44
60	31	10	33	27	35	47	38	10	40	38	43	10	45	47	47	8	48	31	49	56	51	24	52	54
61	32	16	34	39	37	5	39	36	42	11	44	52	47	40	49	7	50	36	52	7	53	42	55	20
62	33	27	35	57	38	31	41	10	43	54	46	46	49	46	51	19	52	56	54	36	56	20	58	9
63	34	45	37	23	40	5	42	54	45	49	48	53	52	8	53	50	55	36	57	27	59	23	61	26
64	36	11	38	58	41	50	44	49	47	58	51	17	54	50	56	44	58	43	60	48	63	2	65	27
65	37	46	40	43	43	46	46	59	50	23	54	2	57	59	60	8	62	25	64	53	67	30	70	59
66	39	31	42	40	45	57	49	27	53	10	57	14	61	46	64	18	67	4	70	12	73	52	78	38

TABLE XIII.

SEMIDIURNAL AND SEMINOCTURNAL ARCHES,

For finding the Time of the Rising and Setting of the Sun, Moon, or Stars.

DECLINATION.

Lat.	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	Lat.
°	h. m	h. m	h. m	h. m	h. m	h. m	h. m	h. m	h. m	h. m	h. m	h. m	h. m	h. m	h. m	h. m	°
1	6 00	6 00	6 00	6 00	6 00	6 00	6 00	6 01	6 01	6 01	6 01	6 01	6 01	6 01	6 01	6 01	1
3	6 00	6 00	6 01	6 01	6 01	6 01	6 01	6 02	6 02	6 02	6 02	6 03	6 03	6 03	6 03	6 03	3
5	6 00	6 01	6 01	6 01	6 02	6 02	6 02	6 03	6 03	6 04	6 04	6 04	6 05	6 05	6 05	6 06	5
7	6 00	6 01	6 01	6 02	6 02	6 03	6 03	6 04	6 04	6 05	6 05	6 06	6 06	6 07	6 08	6 08	7
9	6 01	6 01	6 02	6 03	6 03	6 04	6 04	6 05	6 06	6 06	6 07	6 08	6 08	6 09	6 10	6 10	9
11	6 01	6 02	6 02	6 03	6 04	6 05	6 05	6 06	6 07	6 08	6 09	6 09	6 10	6 11	6 12	6 13	11
13	6 01	6 02	6 03	6 04	6 05	6 06	6 06	6 07	6 08	6 09	6 10	6 11	6 12	6 13	6 14	6 15	13
14	6 01	6 02	6 03	6 04	6 05	6 06	6 07	6 08	6 09	6 10	6 11	6 12	6 13	6 14	6 15	6 16	14
15	6 01	6 02	6 03	6 04	6 05	6 06	6 08	6 09	6 10	6 11	6 12	6 13	6 14	6 15	6 16	6 18	15
16	6 01	6 02	6 03	6 05	6 06	6 07	6 08	6 09	6 10	6 12	6 13	6 14	6 15	6 16	6 18	6 19	16
17	6 01	6 02	6 04	6 05	6 06	6 07	6 09	6 10	6 11	6 12	6 14	6 15	6 16	6 17	6 19	6 20	17
18	6 01	6 03	6 04	6 05	6 07	6 08	6 09	6 10	6 12	6 13	6 14	6 16	6 17	6 19	6 20	6 21	18
19	6 01	6 03	6 04	6 06	6 07	6 08	6 10	6 11	6 13	6 14	6 15	6 17	6 18	6 20	6 21	6 23	19
20	6 01	6 03	6 04	6 06	6 07	6 09	6 10	6 12	6 13	6 15	6 16	6 18	6 19	6 21	6 22	6 24	20
21	6 02	6 03	6 05	6 06	6 08	6 09	6 11	6 12	6 14	6 16	6 17	6 19	6 20	6 22	6 24	6 25	21
22	6 02	6 03	6 05	6 06	6 08	6 10	6 11	6 13	6 15	6 16	6 18	6 20	6 21	6 23	6 25	6 27	22
23	6 02	6 03	6 05	6 07	6 09	6 10	6 12	6 14	6 15	6 17	6 19	6 21	6 22	6 24	6 26	6 28	23
24	6 02	6 04	6 05	6 07	6 09	6 11	6 13	6 14	6 16	6 18	6 20	6 22	6 24	6 26	6 27	6 29	24
25	6 02	6 04	6 06	6 07	6 09	6 11	6 13	6 15	6 17	6 19	6 21	6 23	6 25	6 27	6 29	6 31	25
26	6 02	6 04	6 06	6 08	6 10	6 12	6 14	6 16	6 18	6 20	6 22	6 24	6 26	6 28	6 30	6 32	26
27	6 02	6 04	6 06	6 08	6 10	6 12	6 14	6 16	6 19	6 21	6 23	6 25	6 27	6 29	6 31	6 34	27
28	6 02	6 04	6 06	6 09	6 11	6 13	6 15	6 17	6 19	6 22	6 24	6 26	6 28	6 30	6 33	6 35	28
29	6 02	6 04	6 07	6 09	6 11	6 13	6 16	6 18	6 20	6 22	6 25	6 27	6 29	6 32	6 34	6 37	29
30	6 02	6 05	6 07	6 09	6 12	6 14	6 16	6 19	6 21	6 23	6 26	6 28	6 31	6 33	6 36	6 38	30
31	6 02	6 05	6 07	6 10	6 12	6 14	6 17	6 19	6 22	6 24	6 27	6 29	6 32	6 34	6 37	6 40	31
32	6 02	6 05	6 08	6 10	6 13	6 15	6 18	6 20	6 23	6 25	6 28	6 31	6 33	6 36	6 39	6 41	32
33	6 03	6 05	6 08	6 10	6 13	6 16	6 18	6 21	6 24	6 26	6 29	6 32	6 34	6 37	6 40	6 43	33
34	6 03	6 05	6 08	6 11	6 14	6 16	6 19	6 22	6 25	6 27	6 30	6 33	6 36	6 39	6 42	6 45	34
35	6 03	6 06	6 08	6 11	6 14	6 17	6 20	6 23	6 25	6 28	6 31	6 34	6 37	6 40	6 43	6 46	35
36	6 03	6 06	6 09	6 12	6 15	6 18	6 20	6 23	6 26	6 29	6 32	6 36	6 39	6 42	6 45	6 48	36
37	6 03	6 06	6 09	6 12	6 15	6 18	6 21	6 24	6 27	6 31	6 34	6 37	6 40	6 43	6 47	6 50	37
38	6 03	6 06	6 09	6 13	6 16	6 19	6 22	6 25	6 28	6 32	6 35	6 38	6 42	6 45	6 48	6 52	38
39	6 03	6 06	6 10	6 13	6 16	6 20	6 23	6 26	6 29	6 33	6 36	6 40	6 43	6 47	6 50	6 54	39
40	6 03	6 07	6 10	6 13	6 17	6 20	6 24	6 27	6 31	6 34	6 38	6 41	6 45	6 48	6 52	6 56	40
41	6 03	6 07	6 10	6 14	6 17	6 21	6 25	6 28	6 32	6 35	6 39	6 43	6 46	6 50	6 54	6 58	41
42	6 04	6 07	6 11	6 14	6 18	6 22	6 25	6 29	6 33	6 37	6 40	6 44	6 48	6 52	6 56	7 00	42
43	6 04	6 07	6 11	6 15	6 19	6 22	6 26	6 30	6 34	6 38	6 42	6 46	6 50	6 54	6 58	7 02	43
44	6 04	6 08	6 12	6 15	6 19	6 23	6 27	6 31	6 35	6 39	6 43	6 47	6 52	6 56	7 00	7 04	44
45	6 04	6 08	6 12	6 16	6 20	6 24	6 28	6 32	6 36	6 41	6 45	6 49	6 53	6 58	7 02	7 07	45
46	6 04	6 08	6 12	6 17	6 21	6 25	6 29	6 33	6 38	6 42	6 46	6 51	6 55	7 00	7 04	7 09	46
47	6 04	6 09	6 13	6 17	6 22	6 26	6 30	6 35	6 39	6 44	6 48	6 53	6 57	7 02	7 07	7 12	47
48	6 04	6 09	6 13	6 18	6 22	6 27	6 31	6 36	6 41	6 45	6 50	6 55	6 59	7 04	7 09	7 14	48
49	6 05	6 09	6 14	6 18	6 23	6 28	6 32	6 37	6 42	6 47	6 52	6 57	7 02	7 07	7 12	7 17	49
50	6 05	6 10	6 14	6 19	6 24	6 29	6 34	6 39	6 44	6 49	6 54	6 59	7 04	7 09	7 14	7 20	50
51	6 05	6 10	6 15	6 20	6 25	6 30	6 35	6 40	6 45	6 50	6 56	7 01	7 06	7 12	7 17	7 23	51
52	6 05	6 10	6 15	6 21	6 26	6 31	6 36	6 41	6 47	6 52	6 58	7 03	7 09	7 14	7 20	7 26	52
53	6 05	6 11	6 16	6 21	6 27	6 32	6 38	6 43	6 49	6 54	7 00	7 06	7 11	7 17	7 23	7 29	53
54	6 06	6 11	6 17	6 22	6 28	6 33	6 39	6 45	6 50	6 56	7 02	7 08	7 14	7 20	7 27	7 33	54
55	6 06	6 11	6 17	6 23	6 29	6 35	6 40	6 46	6 52	6 58	7 04	7 11	7 17	7 23	7 30	7 37	55
56	6 06	6 12	6 18	6 24	6 30	6 36	6 42	6 48	6 54	7 01	7 07	7 13	7 20	7 27	7 34	7 41	56
57	6 06	6 12	6 19	6 25	6 31	6 37	6 44	6 50	6 56	7 03	7 10	7 16	7 23	7 30	7 37	7 45	57
58	6 06	6 13	6 19	6 26	6 32	6 39	6 45	6 52	6 59	7 06	7 12	7 20	7 27	7 34	7 42	7 49	58
59	6 07	6 13	6 20	6 27	6 33	6 40	6 47	6 54	7 01	7 08	7 16	7 23	7 30	7 38	7 46	7 54	59
60	6 07	6 14	6 21	6 28	6 35	6 42	6 49	6 56	7 04	7 11	7 19	7 26	7 34	7 42	7 51	7 59	60
61	6 07	6 14	6 22	6 29	6 36	6 44	6 51	6 59	7 06	7 14	7 22	7 30	7 38	7 47	7 56	8 05	61
62	6 08	6 15	6 23	6 30	6 38	6 46	6 53	7 01	7 09	7 17	7 26	7 34	7 43	7 52	8 01	8 11	62
63	6 08	6 16	6 24	6 32	6 40	6 48	6 56	7 04	7 12	7 21	7 30	7 39	7 48	7 57	8 07	8 17	63
64	6 08	6 16	6 25	6 33	6 41	6 50	6 58	7 07	7 16	7 25	7 34	7 43	7 53	8 03	8 13	8 24	64
65	6 09	6 17	6 26	6 34	6 43	6 52	7 01	7 10	7 19	7 29	7 39	7 48	7 59	8 09	8 20	8 32	65
66	6 09	6 18	6 27	6 36	6 45	6 55	7 04	7 14	7 23	7 33	7 42	7 54	8 05	8 16	8 28	8 40	56

TABLE XIII.

SEMIDIURNAL AND SEMINOCTURNAL ARCHES,

For finding the Time of the Rising and Setting of the Sun, Moon, or Stars.

DECLINATION.

Lat.	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	30°	Lat.
°	h. m	h. m	h. m	h. m	h. m	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	°
1	6 01	6 01	6 01	6 01	6 02	6 02	6 02	6 02	6 02	6 02	6 02	6 02	6 02	6 02	1
3	6 04	6 04	6 04	6 04	6 05	6 05	6 05	6 05	6 06	6 06	6 06	6 06	6 07	6 07	3
5	6 06	6 07	6 07	6 07	6 08	6 08	6 09	6 09	6 09	6 10	6 10	6 11	6 11	6 12	5
7	6 09	6 09	6 10	6 10	6 11	6 11	6 12	6 13	6 13	6 14	6 14	6 15	6 16	6 16	7
9	6 11	6 12	6 13	6 13	6 14	6 15	6 15	6 16	6 17	6 18	6 19	6 19	6 20	6 21	9
11	6 14	6 14	6 15	6 16	6 17	6 18	6 19	6 20	6 21	6 22	6 23	6 24	6 25	6 26	11
13	6 16	6 17	6 18	6 19	6 20	6 21	6 22	6 24	6 25	6 26	6 27	6 28	6 29	6 31	13
14	6 17	6 19	6 20	6 21	6 22	6 23	6 24	6 25	6 27	6 28	6 29	6 30	6 32	6 33	14
15	6 19	6 20	6 21	6 22	6 24	6 25	6 26	6 27	6 29	6 30	6 31	6 33	6 34	6 36	15
16	6 20	6 21	6 23	6 24	6 25	6 27	6 28	6 29	6 31	6 32	6 34	6 35	6 37	6 38	16
17	6 21	6 23	6 24	6 26	6 27	6 28	6 30	6 31	6 33	6 34	6 36	6 37	6 39	6 41	17
18	6 23	6 24	6 26	6 27	6 29	6 30	6 32	6 33	6 35	6 36	6 38	6 40	6 41	6 43	18
19	6 24	6 26	6 27	6 29	6 30	6 32	6 34	6 35	6 37	6 39	6 40	6 42	6 44	6 46	19
20	6 26	6 27	6 29	6 30	6 32	6 34	6 36	6 37	6 39	6 41	6 43	6 45	6 47	6 49	20
21	6 27	6 29	6 30	6 32	6 34	6 36	6 38	6 39	6 41	6 43	6 45	6 47	6 49	6 51	21
22	6 28	6 30	6 32	6 34	6 36	6 38	6 39	6 41	6 43	6 45	6 48	6 50	6 52	6 54	22
23	6 30	6 32	6 34	6 36	6 38	6 39	6 42	6 44	6 46	6 48	6 50	6 52	6 54	6 57	23
24	6 31	6 33	6 35	6 37	6 39	6 41	6 44	6 46	6 48	6 50	6 52	6 55	6 57	7 00	24
25	6 33	6 35	6 37	6 39	6 41	6 43	6 46	6 48	6 50	6 53	6 55	6 57	7 00	7 02	25
26	6 34	6 36	6 39	6 41	6 43	6 45	6 48	6 50	6 53	6 55	6 58	7 00	7 03	7 05	26
27	6 36	6 38	6 40	6 43	6 45	6 48	6 50	6 52	6 55	6 58	7 00	7 03	7 06	7 08	27
28	6 37	6 40	6 42	6 45	6 47	6 50	6 52	6 55	6 57	7 00	7 03	7 06	7 09	7 11	28
29	6 39	6 42	6 44	6 47	6 49	6 52	6 54	6 57	7 00	7 03	7 06	7 09	7 12	7 15	29
30	6 41	6 43	6 46	6 49	6 51	6 54	6 57	7 00	7 02	7 05	7 08	7 11	7 15	7 18	30
31	6 42	6 45	6 48	6 51	6 53	6 56	6 59	7 02	7 05	7 08	7 11	7 14	7 18	7 21	31
32	6 44	6 47	6 50	6 53	6 56	6 58	7 01	7 05	7 08	7 11	7 14	7 18	7 21	7 25	32
33	6 46	6 49	6 52	6 55	6 58	7 01	7 04	7 07	7 11	7 14	7 17	7 21	7 24	7 28	33
34	6 48	6 51	6 54	6 57	7 00	7 03	7 07	7 10	7 13	7 17	7 20	7 24	7 28	7 32	34
35	6 49	6 53	6 56	6 59	7 02	7 06	7 09	7 13	7 16	7 20	7 24	7 27	7 31	7 35	35
36	6 51	6 55	6 58	7 01	7 05	7 08	7 12	7 16	7 19	7 23	7 27	7 31	7 35	7 39	36
37	6 53	6 57	7 00	7 04	7 07	7 11	7 15	7 18	7 22	7 26	7 30	7 34	7 39	7 43	37
38	6 55	6 59	7 02	7 06	7 10	7 14	7 17	7 21	7 25	7 30	7 34	7 38	7 43	7 47	38
39	6 57	7 01	7 05	7 09	7 12	7 16	7 20	7 25	7 29	7 33	7 37	7 42	7 47	7 51	39
40	6 59	7 03	7 07	7 11	7 15	7 19	7 23	7 28	7 32	7 37	7 41	7 46	7 51	7 56	40
41	7 02	7 06	7 10	7 14	7 18	7 22	7 27	7 31	7 36	7 40	7 45	7 50	7 55	8 00	41
42	7 04	7 08	7 12	7 17	7 21	7 25	7 30	7 35	7 39	7 44	7 49	7 55	8 00	8 05	42
43	7 06	7 11	7 15	7 19	7 24	7 29	7 33	7 38	7 43	7 48	7 53	7 59	8 04	8 10	53
44	7 09	7 13	7 18	7 22	7 27	7 32	7 37	7 42	7 47	7 52	7 58	8 04	8 09	8 16	44
45	7 11	7 16	7 21	7 25	7 30	7 35	7 40	7 46	7 51	7 57	8 03	8 08	8 15	8 21	45
46	7 14	7 19	7 24	7 29	7 34	7 39	7 44	7 50	7 55	8 01	8 07	8 14	8 20	8 27	46
47	7 17	7 22	7 27	7 32	7 37	7 43	7 48	7 54	8 00	8 06	8 12	8 19	8 26	8 33	47
48	7 19	7 25	7 30	7 35	7 41	7 47	7 53	7 59	8 05	8 11	8 18	8 25	8 32	8 40	48
49	7 22	7 28	7 33	7 39	7 45	7 51	7 57	8 03	8 10	8 17	8 24	8 31	8 38	8 46	49
50	7 25	7 31	7 37	7 43	7 49	7 55	8 02	8 08	8 15	8 22	8 30	8 37	8 45	8 54	50
51	7 29	7 35	7 41	7 47	7 53	8 00	8 06	8 13	8 21	8 28	8 36	8 44	8 53	9 02	51
52	7 32	7 38	7 45	7 51	7 58	8 05	8 12	8 19	8 27	8 35	8 43	8 52	9 01	9 11	52
53	7 36	7 42	7 49	7 56	8 02	8 10	8 17	8 25	8 33	8 41	8 50	9 00	9 09	9 20	53
54	7 40	7 46	7 53	8 00	8 08	8 15	8 23	8 31	8 40	8 49	8 58	9 08	9 19	9 30	54
55	7 44	7 51	7 58	8 05	8 13	8 21	8 29	8 38	8 47	8 57	9 07	9 18	9 29	9 42	55
56	7 48	7 55	8 03	8 11	8 19	8 27	8 36	8 45	8 55	9 05	9 16	9 28	9 41	9 55	56
57	7 52	8 00	8 08	8 16	8 25	8 34	8 43	8 53	9 04	9 15	9 27	9 40	9 54	10 11	57
58	7 57	8 05	8 14	8 22	8 32	8 41	8 51	9 02	9 13	9 25	9 38	9 53	10 10	10 30	58
59	8 02	8 11	8 20	8 29	8 39	8 49	9 00	9 11	9 24	9 37	9 52	10 09	10 29	10 56	59
60	8 08	8 17	8 26	8 36	8 47	8 58	9 09	9 22	9 35	9 51	10 08	10 28	10 55	12 00	60
61	8 14	8 24	8 34	8 44	8 55	9 07	9 20	9 34	9 49	10 07	10 27	10 54	12 00		61
62	8 20	8 31	8 42	8 53	9 05	9 18	9 32	9 47	10 05	10 26	10 54	12 00			62
63	8 27	8 38	8 50	9 02	9 16	9 30	9 46	10 04	10 25	10 53	12 00				63
64	8 35	8 47	9 00	9 13	9 28	9 44	10 02	10 24	10 52	12 00					64
65	8 44	8 57	9 10	9 25	9 42	10 00	10 22	10 51	12 00						65
66	8 53	9 07	9 23	9 39	9 58	10 21	10 50	12 00							66

TABLE XIV.

The RIGHT ASCENSIONS and DECLINATIONS of the PRINCIPAL FIXED STARS, adapted to the beginning of the YEAR 1820.

Charact.	Constellations.	Pr. Names.	Magnitudes.	Right Ascension in Time. h.	m.	s.	Ann. Var. s.	Declination. °	′	″	Ann. Var. ″
γ	Pegasus	*Algenib*	2	0	3	59	+ 3.08	14	11	0N	+ 20.20
α	Cassiopeia	*Scheaar*	3	0	30	21	+ 3.31	55	32	56N	+ 19.80
α	Ursa Minor	*Pole Star*	2	0	57	1	+14.26	88	20	54N	+ 19.45
β	Andromeda	*Mirach*	2	0	59	39	+ 3.30	34	39	52N	+ 19.41
α	Eridanus	*Achernar*	1	1	31	0	+ 2.24	58	9	13S	− 18.52
α	Aries	ARIETIS	2	1	57	3	+ 3.35	22	36	25N	+ 17.40
α	Cetus	*Menkar*	2	2	52	53	+ 3.12	3	22	42N	+ 14.75
β	Perseus	*Algol*	Var.	2	56	29	+ 3.85	40	15	18N	+ 14.51
α	Perseus		2	3	11	31	+ 4.20	49	12	42N	+ 13.50
α	Taurus	ALDEBARAN	1	4	25	36	+ 3.43	16	8	20N	+ 7.95
α	Auriga	*Capella*	1	5	3	25	+ 4.41	45	48	12N	+ 4.57
β	Orion	*Rigel*	1	5	5	54	+ 2.88	8	25	0S	− 4.92
β	Taurus		2	5	14	55	+ 3.78	28	26	43N	+ 3.83
η	Orion	*Bellatrix*	2	5	15	29	+ 3.21	6	10	41N	+ 4.01
δ	Orion		2	5	22	49	+ 3.06	0	26	26S	− 3.37
ε	Orion		2	5	27	4	+ 3.04	1	19	28S	− 3.00
α	Columba		2	5	33	9	+ 2.17	34	10	34S	− 2.42
α	Orion	*Betelguese*	1	5	45	26	+ 3.25	7	21	54N	+ 1.37
α	Argo	*Canopus*	1	6	19	57	+ 1.33	52	35	59S	+ 1.68
α	Canis Major	*Sirius*	1	6	37	13	+ 2.61	16	28	31S	+ 4.36
α	Gemini	*Castor*	1	7	23	6	+ 3.85	32	16	24N	− 7.06
α	Canis Minor	*Procyon*	1	7	29	53	+ 3.15	5	40	46N	− 8.54
β	Gemini	POLLUX	1	7	34	17	+ 3.69	28	27	8N	− 8.00
ξ	Argo Navis		2	7	57	16	+ 2.11	39	29	58S	+ 9.75
γ	Argo Navis		2	8	4	0	+ 1.85	46	48	30S	+ 10.26
δ	Argo Navis		2	8	39	44	+ 1.66	54	2	57S	+ 12.83
β	Argo Navis		1	9	11	14	+ 0.74	68	58	42S	+ 14.84
α	Hydra	*Alphard*	2	9	18	45	+ 2.95	7	52	57S	+ 15.19
α	Leo	REGULUS	1	9	58	47	+ 3.21	12	50	36N	− 17.33
β	Ursa Major		2	10	50	54	+ 3.71	57	20	42N	− 19.10
α	Ursa Major	*Dubhe*	2	10	52	32	+ 3.83	62	43	13N	− 19.30
β	Leo	*Deneb*	2	11	39	52	+ 3.07	15	34	42N	− 20.04
γ	Ursa Major		2	11	44	19	+ 3.20	54	41	45N	− 20.00
α	Crux		1	12	16	42	+ 3.23	62	6	5S	+ 20.00
γ	Crux		2	12	21	14	+ 3.24	56	6	2S	+ 19.97
α	Virgo	SPICA	1	13	15	44	+ 3.14	10	13	3S	+ 18.95
η	Ursa Major	*Benetnach*	2	13	40	26	+ 2.38	50	12	55N	− 18.20
β	Centaur		1	13	51	13	+ 4.11	59	29	48S	+ 17.80
α	Draco		2	13	59	31	+ 1.63	65	14	21N	− 17.41
α	Bootes	*Arcturus*	1	14	7	27	+ 2.73	20	7	28N	− 18.99
γ	Bootes	*Seginus*	3	14	24	49	+ 2.43	39	5	58N	− 16.20
α	Centaur		1	14	28	0	+ 4.45	60	5	59S	+ 16.11
α	1 Libra	*Zubenesch*	2	14	40	45	+ 3.29	15	14	20S	+ 15.20
β	Libra	*Zubenelg*	2	15	7	20	+ 3.22	8	42	38S	+ 13.67
α	Corona Borealis	*Alphacca*	2	15	27	4	+ 2.53	27	19	37N	− 12.49
α	Serpens		2	15	35	25	+ 2.94	6	59	59N	− 11.73
α	Scorpio	ANTARES	1	16	18	22	+ 3.66	26	1	16S	+ 8.62
α	Hercules	*Ras Algethi*	2	17	6	27	+ 2.73	14	36	14N	− 4.48
α	Ophiuchus	*Ras Alhague*	2	17	26	35	+ 2.77	12	41	59N	− 3.10
γ	Draco	*Rastaban*	3	17	52	26	+ 1.38	51	30	52N	− 0.70
α	Lyra	*Vega*	1	18	30	51	+ 2.03	38	37	21N	+ 3.00
α	AQUILÆ	ALTAIR	1	19	42	0	+ 2.93	8	24	5N	+ 9.06
α	Pavo		1	20	11	20	+ 4.84	57	18	1S	− 10.72
α	Cygnus	*Deneb*	2	20	35	18	+ 2.04	44	38	31N	+ 12.63
α	Cepheus	*Alderaimin*	3	21	14	17	+ 1.42	61	49	32N	+ 14.90
α	Aquarius		3	21	56	32	+ 3.09	1	11	21S	− 17.37
α	Grux		2	21	56	50	+ 3.84	47	49	25S	− 17.14
α	Pisc. Australis	FOMALHAUT	1	22	47	41	+ 3.34	30	34	26S	− 19.10
β	Pegasus	*Scheat*	2	22	55	2	+ 2.87	27	6	19N	+ 19.21
α	PEGASUS	MARCAB	2	22	55	48	+ 2.98	14	14	24N	+ 19.43
α	Andromeda	*Alpheratz*	2	23	59	6	+ 3.08	28	5	50N	+ 19.99

TABLE XV.

For finding the APPARENT TIME of the PRINCIPAL STARS' passing the MERIDIAN throughout the YEAR.

	January.						February.					
	1	6	11	16	21	26	1	6	11	16	21	26
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
Algenib....	5 17	4 56	4 34	4 12	3 51	3 30	3 5	2 46	2 26	2 6	1 47	1 28
Schedar....	5 43	5 21	5 0	4 38	4 17	3 56	3 31	3 11	2 52	2 32	2 13	1 54
Polar Star .	6 10	5 48	5 27	5 5	4 44	4 23	3 58	3 38	3 18	2 59	2 40	2 21
Mirach	6 13	5 51	5 30	5 8	4 47	4 26	4 1	3 41	3 21	3 2	2 43	2 24
Achernar...	6 44	6 22	6 1	5 39	5 18	4 57	4 32	4 12	3 52	3 32	3 13	2 55
α ARIETIS ...	7 10	6 48	6 27	6 5	5 44	5 23	4 58	4 38	4 18	3 58	3 39	3 20
Menkar....	8 6	7 44	7 22	7 1	6 40	6 19	5 54	5 34	5 14	4 54	4 35	4 16
Algol	8 10	7 48	7 26	7 5	6 43	6 22	5 58	5 37	5 17	4 58	4 39	4 20
α Perseus ...	8 24	8 3	7 41	7 20	6 58	6 37	6 13	5 52	5 32	5 13	4 54	4 35
ALDEBARAN	9 38	9 16	8 54	8 33	8 12	7 51	7 27	7 6	6 46	6 27	6 8	5 49
Capella	10 16	9 54	9 32	9 11	8 49	8 29	8 4	7 44	7 24	7 5	6 46	6 27
Rigel......	10 18	9 56	9 34	9 13	8 52	8 32	8 7	7 47	7 27	7 7	6 48	6 29
β Taurus	10 27	10 5	9 44	9 22	9 1	8 40	8 16	7 56	7 36	7 16	6 57	6 38
Bellatrix...	10 28	10 6	9 44	9 22	9 1	8 40	8 17	7 56	7 36	7 17	6 58	6 39
δ Orion......	10 35	10 13	9 51	9 30	9 9	8 48	8 24	8 4	7 44	7 24	7 5	6 46
ε Orion	10 40	10 17	9 56	9 34	9 13	8 52	8 28	8 8	7 48	7 28	7 9	6 50
α Columba...	10 46	10 24	10 2	9 40	9 19	8 58	8 34	8 14	7 54	7 35	7 15	6 56
Betelguese .	10 58	10 36	10 14	9 52	9 31	9 10	8 46	8 26	8 6	7 47	7 28	7 9
Canopus ...	11 32	11 10	10 49	10 27	10 6	9 45	9 20	9 0	8 41	8 21	8 2	7 43
Sirius	11 50	11 28	11 6	10 44	10 23	10 2	9 37	9 17	8 58	8 39	8 19	8 0
Castor	12 36	12 14	11 52	11 30	11 9	10 48	10 23	10 3	9 43	9 23	9 5	8 46
Procyon ...	12 42	12 20	11 58	11 37	11 16	10 55	10 30	10 10	9 50	9 30	9 12	8 53
POLLUX....	12 47	12 25	12 3	11 41	11 20	10 59	10 34	10 14	9 54	9 35	9 16	8 57
ξ Argo Navis	13 10	12 48	12 25	12 4	11 43	11 22	10 57	10 37	10 17	9 58	9 38	9 20
γ Argo Navis	13 16	12 54	12 33	12 11	11 50	11 29	11 4	10 44	10 24	10 4	9 45	9 27
δ Argo Navis	13 52	13 30	13 8	12 47	12 25	12 4	11 40	11 20	11 0	10 40	10 21	10 2
β Argo Navis	14 23	14 1	13 39	13 18	12 57	12 36	12 11	11 51	11 31	11 12	10 52	10 33
Alphard....	14 30	14 8	13 46	13 26	13 4	12 44	12 19	11 59	11 39	11 19	11 0	10 41
REGULUS ...	15 10	14 48	14 26	14 5	13 45	13 24	12 59	12 39	12 19	11 59	11 40	11 21
β Ursa Major	16 2	15 41	15 18	13 57	14 36	14 16	13 51	13 31	13 11	12 51	12 32	12 13
Dubhe	16 4	15 42	15 20	14 59	14 37	14 17	13 53	13 32	13 12	12 53	12 34	12 15
Deneb	16 51	16 29	16 7	15 46	15 25	15 4	14 40	14 20	14 0	13 40	13 21	13 2
γ Ursa Major	16 56	16 34	16 12	15 50	15 29	15 8	14 44	14 24	14 4	13 45	13 25	13 6
α Crux......	17 28	17 6	16 44	16 23	16 1	15 40	15 16	14 57	14 37	14 17	13 58	13 39
γ Crux	17 33	17 11	16 49	16 27	16 6	15 45	15 20	15 1	14 41	14 22	14 2	13 43
SPICA......	18 27	18 5	17 43	17 22	17 1	16 39	16 15	15 55	15 35	15 16	14 57	14 38
Benetnasch .	18 52	18 30	18 8	17 46	17 25	17 4	16 39	16 19	15 59	15 40	15 22	15 2
β Centaur ...	19 3	18 41	18 19	17 57	17 36	17 15	16 50	16 30	16 10	15 51	15 32	15 12
α Draco	19 11	18 49	18 27	18 6	17 44	17 23	16 59	16 38	16 18	15 59	15 40	15 21
Arcturus ...	19 19	18 56	18 35	18 13	17 52	17 31	17 6	16 46	16 26	16 7	15 48	15 29
Seginus	19 35	19 13	18 52	18 31	18 11	17 49	17 24	17 4	16 44	16 24	16 5	15 46
α Centaur ...	19 38	19 16	18 56	18 34	18 13	17 52	17 27	17 7	16 47	16 27	16 8	15 49
Zubenesch ..	19 51	19 29	19 7	18 47	18 25	18 5	17 40	17 20	17 0	16 40	16 21	16 2
Zubenelg ...	20 18	19 56	19 34	19 13	18 52	18 31	18 6	17 46	17 26	17 7	16 47	16 28
Alphacca ...	20 38	20 15	19 54	19 32	19 12	18 51	18 26	18 6	17 46	17 26	17 7	16 48
α Serpens....	20 46	20 24	20 2	19 42	19 21	18 59	18 34	18 14	17 54	17 35	17 16	16 57
ANTARES ..	21 29	21 7	20 45	20 23	20 2	19 42	19 17	18 57	18 37	18 18	17 58	17 39
Ras Algethi	22 17	21 55	21 33	21 11	20 50	20 29	20 5	19 45	19 25	19 6	18 47	18 28
Ras Alhague	22 37	22 15	21 53	21 32	21 10	20 49	20 26	20 5	19 46	19 26	19 7	18 48
Rastaban...	23 3	22 41	22 19	21 57	21 36	21 15	20 50	20 29	20 11	19 52	19 33	19 14
Vega	23 41	23 19	22 57	22 36	22 15	21 54	21 29	21 10	20 50	20 30	20 11	19 52
α AQUILÆ ...	0 56	0 34	0 13	23 47	23 26	23 5	22 40	22 21	22 0	21 41	21 22	21 3
α Pavo	1 26	1 4	0 42	0 10	23 55	23 34	23 9	22 49	22 29	22 10	21 50	21 31
Deneb	1 50	1 28	1 6	0 44	0 23	0 2	23 33	23 13	22 54	22 34	22 14	21 55
Alderaimin .	2 29	2 7	1 45	1 23	1 2	0 41	0 16	23 52	23 33	23 13	22 53	22 34
α Aquarius ..	3 10	2 48	2 27	2 6	1 44	1 23	0 59	0 38	0 18	23 55	23 36	23 17
α Grux.......	3 10	2 48	2 27	2 6	1 45	1 24	0 59	0 39	0 19	23 55	23 36	23 17
FOMALHAUT	4 1	3 39	3 17	2 56	2 35	2 14	1 50	1 29	1 10	0 50	0 31	0 12
Scheat	4 8	3 46	3 25	3 3	2 42	2 22	1 57	1 37	1 17	0 57	0 38	0 19
MARCAB ...	4 9	3 47	3 25	3 4	2 43	2 23	1 58	1 38	1 18	0 58	0 39	0 20
Alpheratz ..	5 13	4 51	4 29	4 7	3 46	3 25	3 0	2 41	2 21	2 1	1 42	1 23

TABLE XV.

For finding the APPARENT TIME of the PRINCIPAL STARS' passing the MERIDIAN throughout the YEAR.

	March.						April.					
	1	6	11	16	21	26	1	6	11	16	21	26
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
Algenib	1 16	0 57	0 39	0 21	0 2	23 40	23 18	23 1	22 43	22 24	22 6	21 47
Schedar	1 42	1 24	1 5	0 47	0 29	0 11	23 45	23 26	23 8	22 50	22 32	22 13
Polar Star	2 9	1 50	1 32	1 14	0 55	0 37	0 15	23 53	23 35	23 16	22 58	22 39
Mirach	2 12	1 53	1 34	1 16	0 58	0 40	0 18	23 56	23 37	23 19	23 1	22 42
Achernar	2 43	2 24	2 6	1 48	1 29	1 11	0 49	0 31	0 13	23 50	23 32	23 13
α ARIETIS	3 9	2 50	2 32	2 14	1 55	1 37	1 15	0 57	0 39	0 20	23 58	23 39
Menkar	4 4	3 45	3 27	3 9	2 51	2 33	2 11	1 53	1 35	1 16	0 58	0 39
Algol	4 7	3 49	3 30	3 13	2 55	2 37	2 15	1 57	1 38	1 20	1 1	0 43
α Perseus	4 22	4 4	3 45	3 28	3 10	2 52	2 30	2 12	1 53	1 35	1 16	0 58
ALDEBARAN	5 37	5 18	4 59	4 41	4 23	4 5	3 43	3 25	3 7	2 49	2 30	2 12
Capella	6 14	5 56	5 37	5 19	5 1	4 43	4 21	4 3	3 44	3 26	3 8	2 50
Rigel	6 17	5 58	5 40	5 21	5 3	4 45	4 23	4 5	3 47	3 28	3 11	2 52
β Taurus	6 26	6 7	5 49	5 30	5 12	4 54	4 32	4 14	3 56	3 37	3 19	3 1
Bellatrix	6 26	6 8	5 49	5 31	5 13	4 55	4 33	4 16	3 56	3 38	3 19	3 2
δ Orion	6 34	6 15	5 57	5 38	5 20	5 2	4 40	4 22	4 4	3 45	3 27	3 9
ε Orion	6 38	6 19	6 1	5 43	5 24	5 6	4 44	4 26	4 8	3 49	3 31	3 12
α Columba	6 44	6 25	6 7	5 49	5 30	5 12	4 51	4 32	4 14	3 56	3 37	3 18
Betelguese	6 56	6 38	6 19	6 1	5 43	5 25	5 3	5 45	4 26	4 8	3 49	3 31
Canopus	7 31	7 12	6 54	6 35	6 17	5 59	5 37	5 19	5 1	4 42	4 24	4 5
Sirius	7 48	7 29	7 11	6 53	6 35	6 16	5 55	5 36	5 18	5 0	4 41	4 22
Castor	8 34	8 15	7 57	7 39	7 20	7 2	6 40	6 22	6 4	5 46	5 27	5 8
Procyon	8 41	8 22	8 4	7 45	7 27	7 9	6 47	6 29	6 11	5 52	5 34	5 15
POLLUX	8 45	8 27	8 8	7 50	7 32	7 13	6 52	6 33	6 15	5 57	5 38	5 19
ξ Argo Navis	9 8	8 50	8 31	8 13	7 55	7 36	7 15	6 56	6 38	6 20	6 1	5 42
γ Argo Navis	9 15	8 56	8 38	8 20	8 1	7 43	7 21	7 3	6 45	6 26	6 8	5 49
δ Argo Navis	9 50	9 32	9 14	8 55	8 37	8 19	7 57	7 39	7 21	7 2	6 44	6 25
β Argo Navis	10 21	10 3	9 44	9 27	9 9	8 50	8 29	8 10	7 52	7 34	7 15	6 56
Alphard	10 29	10 10	9 52	9 34	9 16	8 58	8 36	8 18	8 0	7 41	7 23	7 4
REGULUS	11 9	10 50	10 32	10 13	9 56	9 38	9 16	8 58	8 40	8 21	8 3	7 44
β Ursa Major	12 1	11 42	11 24	11 5	10 47	10 29	10 7	9 50	9 32	9 13	8 55	8 36
Dubhe	12 2	11 44	11 25	11 7	10 49	10 31	10 9	9 52	9 33	9 15	8 56	8 38
Deneb	12 50	12 31	12 13	11 54	11 36	11 18	10 56	10 38	10 20	10 1	9 43	9 25
γ Ursa Major	12 54	12 30	12 17	11 59	11 41	11 22	11 1	10 42	10 24	10 8	9 47	9 29
α Crux	13 27	13 8	12 50	12 31	12 13	11 55	11 33	11 15	10 57	10 38	10 20	10 1
γ Crux	13 31	13 13	12 54	12 36	12 18	11 59	11 38	11 19	11 1	10 44	10 24	10 5
SPICA	14 26	14 7	13 49	13 30	13 12	12 54	12 32	12 14	11 56	11 38	11 19	11 0
Benetnach	14 50	14 32	14 13	13 55	13 37	13 19	12 57	12 39	12 20	12 3	11 43	11 25
β Centaur	15 1	14 42	14 24	14 6	13 48	13 29	13 8	12 49	12 31	12 13	11 54	11 35
α Draco	15 9	14 51	14 32	14 14	13 56	13 38	13 16	12 58	12 39	12 21	12 2	11 44
Arcturus	15 17	14 59	14 40	14 22	14 4	13 46	13 24	13 6	12 47	12 29	12 10	11 52
Seginus	15 35	15 16	14 57	14 39	14 21	14 3	13 41	13 23	13 5	12 46	12 28	12 9
α Centaur	15 38	15 19	15 0	14 43	14 24	14 6	13 44	13 26	13 8	12 49	12 31	12 12
Zubenesch	15 51	15 32	15 13	14 55	14 37	14 19	13 57	13 39	13 21	13 2	12 44	12 25
Zubenelg	16 16	15 59	15 39	15 22	15 4	14 45	14 24	14 5	13 47	13 29	13 10	12 51
Alphacca	16 36	16 17	15 59	15 42	15 23	15 5	14 44	14 25	14 7	13 48	13 30	13 11
α Serpens	16 44	16 26	16 7	15 50	15 32	15 14	14 52	14 34	14 15	13 57	13 38	13 20
ANTARES	17 27	17 9	16 50	16 32	16 15	15 57	15 35	15 17	14 58	14 40	14 21	14 2
Ras Algethi	18 15	17 57	17 38	17 20	17 2	16 44	16 23	16 5	15 46	15 28	15 9	14 51
Ras Alhague	18 35	18 17	17 58	17 40	17 22	17 4	16 41	16 25	16 6	15 48	15 29	15 11
Rastaban	19 1	18 43	18 24	18 6	17 48	17 30	17 8	16 50	16 31	16 13	15 55	15 37
Vega	19 48	19 21	19 3	18 44	18 26	18 8	17 46	17 28	17 10	16 51	16 33	16 14
α AQUILÆ	20 51	20 32	20 14	19 56	19 37	19 19	18 57	18 39	18 21	18 2	17 44	17 25
α Pavo	21 20	21 2	20 43	20 25	20 7	19 48	19 27	19 8	18 50	18 32	18 13	17 54
Deneb	21 44	21 26	21 7	20 49	20 31	20 12	19 51	19 32	19 14	18 56	18 37	18 18
Alderaimin	22 23	22 5	21 45	21 28	21 10	20 51	20 30	20 11	19 53	19 35	19 16	18 57
α Aquarius	23 4	22 46	22 27	22 10	21 52	21 34	21 12	20 54	20 35	20 17	19 58	19 40
Grux	23 5	22 46	22 28	22 10	21 52	21 34	21 12	20 54	20 36	20 17	19 59	19 40
FOMALHAUT	23 56	23 37	23 19	23 1	22 43	22 25	22 3	21 45	21 27	21 8	20 50	20 31
Scheat	0 7	23 44	23 26	23 8	22 50	22 32	22 10	21 52	21 34	21 15	20 57	20 38
MARCAB	0 8	23 45	23 27	23 8	22 51	22 33	22 10	21 53	21 35	21 16	20 58	20 39
Alpheratz	1 11	0 52	0 34	0 16	23 53	23 35	23 13	22 56	22 38	22 20	22 1	21 42

TABLE XV.

For finding the APPARENT TIME of the PRINCIPAL STARS' passing the MERIDIAN throughout the YEAR.

	May.						June.					
	1	6	11	16	21	26	1	6	11	16	21	26
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
Algenib....	21 28	21 9	20 50	20 30	20 10	19 50	19 26	19 5	18 44	18 24	18 3	17 42
Schedar....	21 54	21 34	21 16	20 56	20 36	20 16	19 52	19 31	19 11	18 50	18 29	18 8
Polar Star .	22 20	22 1	21 42	21 22	21 2	20 43	20 19	19 58	19 37	19 17	18 56	18 35
Mirach	22 23	22 4	21 44	21 25	21 5	20 46	20 20	20 1	19 40	19 19	18 58	18 38
Achernar...	22 54	22 35	22 16	21 56	21 36	21 16	20 52	20 31	20 11	19 51	19 30	19 9
α ARIETIS ...	23 20	23 1	22 42	22 22	22 2	21 42	21 18	20 57	20 36	20 17	19 56	19 35
Menkar....	0 20	0 1	23 37	23 18	22 58	22 38	22 13	21 53	21 32	21 11	20 51	20 30
Algol	0 24	0 4	23 41	23 21	23 2	22 41	22 17	21 56	21 36	21 15	20 54	20 33
α Perseus ...	0 39	0 20	23 56	23 36	23 17	22 56	22 32	22 12	21 51	21 30	21 9	20 49
ALDEBARAN	1 53	1 34	1 14	0 55	0 35	0 15	23 46	23 26	23 5	22 44	22 23	22 3
Capella	2 31	2 11	1 52	1 32	1 12	0 52	0 28	0 7	23 43	23 22	23 1	22 40
Rigel......	2 33	2 14	1 54	1 35	1 15	0 55	0 30	0 10	23 45	23 24	23 4	22 43
β Taurus	2 42	2 23	2 4	1 44	1 24	1 4	0 39	0 19	23 54	23 33	23 13	22 52
Bellatrix...	2 43	2 23	2 4	1 44	1 25	1 4	0 40	0 19	23 55	23 34	23 13	22 52
δ Orion......	2 50	2 31	2 11	1 52	1 32	1 12	0 47	0 27	0 6	23 41	23 21	23 0
ε Orion	2 54	2 35	2 16	1 56	1 36	1 16	0 52	0 31	0 10	23 46	23 25	23 4
α Columba...	3 0	2 41	2 22	2 2	1 42	1 22	0 58	0 37	0 16	23 52	23 31	23 10
Betelguese .	3 11	2 53	2 34	2 14	1 54	1 34	1 10	0 49	0 29	0 8	23 43	23 22
Canopus ...	3 46	3 27	3 9	2 49	2 29	2 9	1 44	1 24	1 3	0 43	0 22	0 1
Sirius	4 3	3 44	3 25	3 6	2 46	2 26	2 2	1 41	1 21	1 0	0 39	0 18
Castor	4 49	4 30	4 11	3 51	3 31	3 11	2 48	2 27	2 6	1 46	1 25	1 4
Procyon ...	4 56	4 37	4 17	3 58	3 38	3 18	2 54	2 34	2 13	1 52	1 32	1 11
POLLUX....	5 0	4 41	4 22	4 2	3 42	3 22	2 59	2 38	2 18	1 57	1 36	1 15
ξ Argo Navis	5 23	5 4	4 45	4 25	4 5	3 45	3 21	3 0	2 41	2 20	1 59	1 38
γ Argo Navis	5 30	5 11	4 52	4 32	4 12	3 52	3 28	3 7	2 47	2 27	2 6	1 45
δ Argo Navis	6 6	5 47	5 27	5 8	4 48	4 28	4 3	3 43	3 22	3 1	2 42	2 21
β Argo Navis	6 37	6 18	5 59	5 39	5 19	4 59	4 35	4 14	3 54	3 33	3 12	2 51
Alphard....	6 45	6 26	6 6	5 47	5 27	5 7	4 42	4 22	4 1	3 40	3 20	2 59
REGULUS ...	7 25	7 6	6 46	6 27	6 7	5 47	5 22	5 2	4 41	4 20	4 0	3 39
β Ursa Major	8 17	7 58	7 38	7 19	6 59	6 39	6 14	5 54	5 33	5 12	4 52	4 31
Dubhe	8 19	8 0	7 40	7 20	7 1	6 40	6 16	5 56	5 35	5 14	4 53	4 33
Deneb	9 6	8 47	8 27	8 8	7 48	7 28	7 3	6 43	6 22	6 1	5 41	5 20
γ Ursa Major	9 10	8 51	8 32	8 12	7 52	7 32	7 8	6 47	6 27	6 6	5 45	5 24
α Crux......	9 42	9 23	9 4	8 45	8 25	8 5	7 40	7 20	6 59	6 38	6 17	5 57
γ Crux	9 46	9 27	9 9	8 49	8 29	8 9	7 45	7 24	7 4	6 43	6 22	6 1
SPICA......	10 41	10 22	10 2	9 43	9 23	9 3	8 39	8 18	7 58	7 37	7 17	6 56
Benetnach..	11 6	10 46	10 27	10 8	9 47	9 27	9 3	8 43	8 23	8 2	7 41	7 20
β Centaur ...	11 16	10 57	10 38	10 18	9 58	9 38	9 14	8 55	8 34	8 13	7 52	7 31
α Draco	11 25	11 6	10 46	10 26	10 7	9 46	9 22	9 2	8 41	8 21	8 0	7 40
Arcturus ...	11 33	11 13	10 54	10 34	10 14	9 54	9 30	9 10	8 49	8 29	8 8	7 47
Seginus	11 50	11 31	11 11	10 52	10 32	10 12	9 47	9 27	9 6	8 46	8 26	8 5
α Centaur ...	11 53	11 34	11 15	10 55	10 35	10 15	9 51	9 30	9 9	8 49	8 29	8 8
Zubenesch ..	12 6	11 47	11 27	11 3	10 48	10 28	10 3	9 43	9 22	9 1	8 42	8 21
Zubenelg ...	12 33	12 13	11 54	11 34	11 14	10 54	10 30	10 9	9 49	9 28	9 7	8 46
Alphacca ...	12 52	12 33	12 14	11 54	11 34	11 14	10 50	10 29	10 8	9 48	9 27	9 6
α Serpens....	13 1	12 41	12 22	12 2	11 42	11 22	10 58	10 37	10 17	9 56	9 35	9 14
ANTARES ..	13 44	13 24	13 5	12 45	12 25	12 5	11 41	11 20	11 0	10 39	10 18	9 57
Ras Algethi	14 32	14 12	13 53	13 33	13 13	12 53	12 29	12 8	11 48	11 27	11 6	10 45
Ras Alhague	14 52	14 33	14 13	13 54	13 34	13 14	12 49	12 29	12 8	11 47	11 26	11 6
Rastaban...	15 18	14 58	14 39	14 19	13 59	13 39	13 15	12 54	12 34	12 13	11 52	11 31
Vega	15 55	15 36	15 17	14 58	14 38	14 18	13 53	13 33	13 12	12 51	12 31	12 10
α AQUILÆ....	17 6	16 47	16 28	16 8	15 48	15 28	15 4	14 43	14 23	14 3	13 42	13 21
α Pavo.	17 36	17 16	16 57	16 37	16 17	15 57	15 33	15 12	14 52	14 31	14 11	13 50
Deneb	17 59	17 40	17 21	17 1	16 41	16 21	15 57	15 36	15 16	14 55	14 34	14 14
Alderaimin .	18 38	18 19	18 0	17 40	17 20	17 0	16 36	16 15	15 55	15 34	15 13	14 52
α Aquarius ..	19 21	19 2	18 42	18 22	18 3	17 42	17 18	16 58	16 37	16 16	15 55	15 35
α Grux......	19 21	19 2	18 42	18 23	18 3	17 43	17 18	16 58	16 37	16 16	15 56	15 35
FOMALHAUT	20 12	19 53	19 33	19 14	18 54	18 34	18 9	17 49	17 28	17 7	16 46	16 26
Scheat	20 19	20 0	19 41	19 21	19 1	18 41	18 17	17 56	17 35	17 15	16 54	16 33
MARCAB ...	20 20	20 1	19 41	19 22	19 2	18 42	18 17	17 57	17 36	17 15	16 55	16 34
Alpheratz ..	21 23	21 4	20 45	20 25	20 5	19 45	19 21	19 0	18 39	18 19	17 58	17 37

TABLE XV.

For finding the APPARENT TIME of the PRINCIPAL STARS' passing the MERIDIAN throughout the YEAR.

	July.						August.					
	1	6	11	16	21	26	1	6	11	16	21	26
	h. m.	h. m.	h. m.	h. m	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
Algenib....	17 21	17 1	16 40	16 20	16 0	15 40	15 17	14 58	14 39	14 20	14 2	13 43
Schedar....	17 48	17 27	17 6	16 46	16 26	16 6	15 43	15 24	15 5	14 47	14 28	14 9
Polar Star .	18 14	17 54	17 33	17 13	16 53	16 33	16 9	15 50	15 32	15 13	14 55	14 36
Mirach	18 17	17 56	17 36	17 15	16 55	16 36	16 12	15 53	15 35	15 16	14 57	14 39
Achernar...	18 48	18 28	18 7	17 47	17 27	17 7	16 43	16 24	16 6	15 47	15 29	15 10
α ARIETIS ...	19 14	18 54	18 33	18 13	17 53	17 33	17 9	16 50	16 31	16 12	15 55	15 36
Menkar....	20 10	19 50	19 29	19 9	18 49	18 29	18 5	17 46	17 27	17 8	16 49	16 31
Algol	20 14	19 53	19 33	19 12	18 52	18 33	18 9	17 50	17 30	17 12	16 53	16 35
α Perseus ...	20 29	20 8	19 48	19 27	19 7	18 47	18 24	18 5	17 46	17 27	17 8	16 50
ALDEBARAN	21 42	21 21	21 1	20 41	20 21	20 1	19 38	19 19	19 0	18 41	18 22	18 4
Capella	22 20	21 59	21 39	21 18	20 59	20 39	20 16	19 56	19 37	19 19	19 0	18 42
Rigel......	22 22	22 2	21 41	21 21	21 2	20 42	20 18	19 59	19 40	19 21	19 2	18 44
β Taurus	22 31	22 11	21 50	21 30	21 10	20 51	20 27	20 8	19 49	19 30	19 11	18 53
Bellatrix...	22 32	22 11	21 51	21 30	21 10	20 51	20 28	20 9	19 49	19 31	19 12	18 54
δ Orion......	22 39	22 18	21 58	21 38	21 18	20 58	20 35	20 16	19 57	19 38	19 19	19 1
ε Orion	22 43	22 23	22 2	21 42	21 22	21 2	20 39	20 20	20 1	19 42	19 24	19 5
α Columba...	22 49	22 29	22 8	21 48	21 28	21 8	20 46	20 26	20 7	19 48	19 30	19 11
Betelguese .	23 2	22 41	22 21	22 0	21 40	21 20	20 58	20 39	20 19	20 1	19 42	19 24
Canopus ...	23 36	23 16	22 55	22 35	22 15	21 55	21 32	21 13	20 54	20 35	20 17	19 58
Sirius	23 53	23 33	23 12	22 52	22 32	22 12	21 50	21 30	21 11	20 52	20 34	20 15
Castor	0 43	0 23	0 2	23 38	23 18	22 58	22 34	22 15	21 56	21 38	21 20	21 1
Procyon ...	0 50	0 30	0 9	23 45	23 25	23 5	22 41	22 22	22 3	21 45	21 26	21 8
POLLUX....	0 55	0 34	0 13	23 49	23 29	23 9	22 46	22 26	22 7	21 50	21 31	21 12
ξ Argo Navis	1 18	0 57	0 36	0 16	23 52	23 32	23 9	22 49	22 30	22 12	21 54	21 35
γ Argo Navis	1 24	1 4	0 43	0 23	0 3	23 39	23 15	22 56	22 37	22 19	22 1	21 42
δ Argo Navis	2 0	1 39	1 19	0 59	0 38	0 19	23 51	23 32	23 13	22 54	22 36	22 18
β Argo Navis	2 31	2 11	1 50	1 30	1 10	0 50	0 27	0 7	23 44	23 25	23 7	22 49
Alphard....	2 39	2 18	1 58	1 38	1 18	0 58	0 34	0 15	23 52	23 33	23 14	22 56
REGULUS ...	3 18	2 58	2 38	2 18	1 58	1 38	1 14	0 55	0 36	0 17	23 54	23 36
β Ursa Major	4 10	3 50	3 29	3 10	2 50	2 30	2 6	1 47	1 28	1 9	0 51	0 32
Dubhe	4 12	3 51	3 31	3 11	2 51	2 31	2 8	1 49	1 30	1 11	0 52	0 34
Deneb	4 59	4 39	4 18	3 58	3 38	3 18	2 55	2 36	2 17	1 58	1 39	1 21
γ Ursa Major	5 4	4 43	4 22	4 2	3 42	3 22	3 0	2 40	2 21	2 3	1 44	1 26
α Crux......	5 36	5 15	4 55	4 35	4 14	3 55	3 31	3 12	2 54	2 35	2 17	1 58
γ Crux... ..	5 40	5 20	4 59	4 39	4 19	3 59	3 36	3 16	2 58	2 39	2 21	2 2
SPICA......	6 35	6 14	5 54	5 34	5 13	4 54	4 30	4 11	3 52	3 33	3 15	2 57
Benetnach..	7 0	6 39	6 19	5 58	5 38	5 18	4 55	4 36	4 16	3 58	3 39	3 22
β Centaur ...	7 10	6 50	6 29	6 9	5 49	5 29	5 6	4 46	4 27	4 8	3 50	3 31
α Draco	7 19	6 58	6 38	6 17	5 57	5 37	5 14	4 55	4 36	4 17	3 58	3 40
Arcturus ...	7 27	7 6	6 46	6 25	6 5	5 45	5 22	5 3	4 43	4 25	4 6	3 48
Seginus	7 44	7 23	7 3	6 43	6 23	6 3	5 39	5 20	5 1	4 42	4 23	4 5
α Centaur ...	7 47	7 27	7 6	6 46	6 26	6 6	5 42	5 23	5 4	4 45	4 27	4 8
Zubenesch .	8 0	7 39	7 19	6 59	6 39	6 19	5 55	5 36	5 17	4 58	4 39	4 21
Zubenelg ...	8 27	8 6	7 45	7 25	7 5	6 45	6 22	6 2	5 43	5 25	5 6	4 47
Alphacca ...	8 46	8 26	8 5	7 45	7 25	7 5	6 41	6 22	6 3	5 44	5 26	5 7
α Serpens....	8 55	8 34	8 14	7 53	7 33	7 13	6 50	6 30	6 11	5 53	5 34	5 16
ANTARES ..	9 37	9 16	8 57	8 36	8 16	7 56	7 33	7 13	6 54	6 36	6 17	5 59
Ras Algethi	10 25	10 5	9 44	9 23	9 4	8 44	8 21	8 2	7 42	7 24	7 5	6 47
Ras Alhague	10 45	10 24	10 4	9 43	9 23	9 3	8 41	8 22	8 3	7 44	7 25	7 7
Rastaban...	11 11	10 50	10 30	10 9	9 49	9 29	9 7	8 48	8 28	8 10	7 51	7 33
Vega	11 49	11 28	11 8	10 48	10 28	10 8	9 44	9 26	9 7	8 48	8 29	8 11
α AQUILÆ....	13 0	12 40	12 19	11 59	11 39	11 19	10 55	10 36	10 17	9 59	9 41	9 22
α Pavo	13 30	13 9	12 48	12 28	12 8	11 48	11 25	11 5	10 46	10 28	10 9	9 51
Deneb	13 54	13 33	13 12	12 52	12 32	12 12	11 49	11 29	11 10	10 51	10 33	10 14
Alderaimin .	14 33	14 12	13 51	13 31	13 11	12 51	12 28	12 8	11 49	11 30	11 12	10 53
α Aquarius ..	15 14	14 53	14 31	14 13	13 53	13 33	13 10	12 51	12 32	12 13	11 54	11 36
α Grux......	15 14	14 53	14 34	14 14	13 54	13 34	13 10	12 51	12 32	12 13	11 54	11 36
FOMALHAUT	16 5	15 44	15 24	15 5	14 44	14 25	14 1	13 42	13 23	13 4	12 45	12 27
Scheat	16 12	15 52	15 31	15 11	14 52	14 32	14 8	13 49	13 30	13 11	12 53	12 34
MARCAB ...	16 13	15 52	15 32	15 12	14 53	14 33	14 9	13 50	13 31	13 12	12 53	12 35
Alpheratz ..	17 16	16 56	16 35	16 15	15 55	15 35	15 12	14 53	14 34	14 15	13 57	13 38

TABLE XV.

For finding the APPARENT TIME of the PRINCIPAL STARS' passing the MERIDIAN throughout the YEAR.

	September.						October.					
	1	6	11	16	21	26	1	6	11	16	21	26
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
Algenib	13 21	13 3	12 45	12 27	12 9	11 51	11 33	11 15	10 57	10 38	10 19	10 0
Schedar	13 48	13 30	13 10	12 54	12 36	12 18	12 0	11 41	11 23	11 4	10 46	10 27
Polar Star .	14 14	13 56	13 37	13 20	13 2	12 44	12 26	12 8	11 50	11 31	11 12	10 53
Mirach	14 17	14 0	13 40	13 23	13 5	12 47	12 29	12 11	11 52	11 34	11 15	10 56
Achernar ...	14 48	14 30	14 12	13 54	13 36	13 18	13 0	12 42	12 24	12 5	11 46	11 27
α ARIETIS ...	15 14	14 56	14 38	14 20	14 2	13 44	13 26	13 8	12 50	12 31	12 12	11 53
Menkar	16 10	15 52	15 34	15 16	14 58	14 40	14 22	14 4	13 46	13 27	13 8	12 49
Algol	16 14	15 56	15 38	15 20	15 2	14 44	14 26	14 7	13 49	13 31	13 12	12 53
α Perseus ...	16 29	16 11	15 53	15 35	15 17	14 59	14 41	14 23	14 4	13 46	13 27	13 8
ALDEBARAN	17 42	17 24	17 6	16 49	16 31	16 13	15 55	15 37	15 18	15 0	14 41	14 22
Capella	18 20	18 2	17 44	17 26	17 9	16 50	16 33	16 14	15 56	15 38	15 19	15 0
Rigel	18 22	18 4	17 46	17 28	17 10	16 52	16 35	16 17	16 0	15 40	15 21	15 2
β Taurus	18 31	18 13	17 55	17 37	17 19	17 1	16 44	16 26	16 8	15 49	15 30	15 11
Bellatrix ...	18 32	18 14	17 56	17 38	17 20	17 2	16 45	16 26	16 8	15 50	15 31	15 12
δ Orion	18 39	18 21	18 3	17 45	17 27	17 9	16 51	16 34	16 15	15 57	15 38	15 19
ε Orion	18 43	18 25	18 7	17 49	17 31	17 13	16 55	16 37	16 20	16 1	15 42	15 23
α Columba ...	18 49	18 31	18 13	17 55	17 37	17 19	17 1	16 43	16 26	16 7	15 48	15 29
Betelguese .	19 2	18 44	18 26	18 8	17 50	17 32	17 14	16 55	16 37	16 20	16 0	15 42
Canopus ...	19 36	19 18	19 0	18 42	18 24	18 6	17 48	17 30	17 12	16 53	16 34	16 15
Sirius	19 53	19 35	19 17	18 59	18 41	18 23	18 5	17 47	17 29	17 10	16 52	16 32
Castor	20 39	20 21	20 3	19 45	19 27	19 9	18 51	18 33	18 15	17 57	17 37	17 18
Procyon ...	20 46	20 28	20 10	19 52	19 34	19 16	18 58	18 40	18 22	18 4	17 44	17 25
POLLUX	20 51	20 32	20 14	19 56	19 39	19 21	19 2	18 44	18 27	18 7	17 49	17 30
ξ Argo Navis	21 14	20 55	20 37	20 19	20 1	19 44	19 25	19 7	18 49	18 30	18 12	17 53
γ Argo Navis	21 20	21 2	20 44	20 26	20 8	19 50	19 32	19 14	18 56	18 37	18 18	18 0
δ Argo Navis	21 56	21 38	21 20	21 2	20 44	20 26	20 8	19 50	19 31	19 13	18 54	18 35
β Argo Navis	22 26	22 9	21 51	21 33	21 15	20 57	20 39	20 21	20 3	19 44	19 26	19 6
Alphard	22 34	22 17	22 0	21 41	21 23	21 5	20 47	20 29	20 10	19 52	19 33	19 14
REGULUS ...	23 14	22 57	22 39	22 21	22 3	21 45	21 27	21 9	20 50	20 32	20 13	19 54
β Ursa Major	0 10	23 48	23 30	23 12	22 55	22 37	22 19	22 1	21 43	21 24	21 5	20 46
Dubhe	0 12	23 50	23 32	23 14	22 57	22 39	22 21	22 3	21 44	21 26	21 7	20 48
Deneb	0 59	0 41	0 23	0 5	23 43	23 25	23 8	22 50	22 32	22 13	21 54	21 35
γ Ursa Major	1 4	0 45	0 27	0 10	23 48	23 30	23 12	22 54	22 36	22 17	22 0	21 40
α Crux	1 36	1 18	1 0	0 42	0 24	0 6	23 44	23 26	23 8	22 50	22 31	22 12
γ Crux	1 40	1 22	1 4	0 46	0 28	0 10	23 48	23 30	23 12	22 54	22 36	22 16
SPICA	2 35	2 17	1 59	1 41	1 23	1 5	0 47	0 29	0 10	23 48	23 30	23 10
Benetnach ..	3 0	2 42	2 24	2 6	1 48	1 30	1 12	0 53	0 35	0 17	23 54	23 35
β Centaur ...	3 10	2 52	2 34	2 16	1 58	1 40	1 22	1 4	0 46	0 27	0 9	23 45
α Draco	3 19	3 1	2 43	2 25	2 7	1 49	1 31	1 13	0 54	0 36	0 17	23 54
Arcturus ...	3 26	3 9	2 51	2 33	2 15	1 57	1 39	1 20	1 2	0 44	0 25	0 6
Seginus	3 43	3 26	3 8	2 50	2 32	2 14	1 56	1 38	1 19	1 1	0 42	0 23
α Centaur ...	3 46	3 29	3 11	2 53	2 35	2 17	1 59	1 41	1 23	1 4	0 45	0 26
Zubenesch ..	3 59	3 41	3 24	3 6	2 48	2 30	2 12	1 54	1 35	1 17	0 58	0 39
Zubenelg ...	4 26	4 7	3 49	3 32	3 15	2 57	2 39	2 20	2 2	1 43	1 25	1 6
Alphacca ...	4 45	4 27	4 9	3 51	3 34	3 16	2 58	2 40	2 22	2 3	1 44	1 25
α Serpens	4 54	4 36	4 18	4 0	3 42	3 24	3 7	2 48	2 30	2 12	1 53	1 34
ANTARES ..	5 37	5 19	5 1	4 43	4 25	4 7	3 49	3 30	3 13	2 54	2 36	2 17
Ras Algethi	6 25	6 7	5 49	5 31	5 13	4 55	4 37	4 18	4 0	3 42	3 23	3 5
Ras Alhague	6 45	6 27	6 9	5 51	5 33	5 15	4 57	4 39	4 20	4 2	3 43	3 24
Rastaban ...	7 11	6 53	6 35	6 17	5 59	5 41	5 23	5 4	4 46	4 27	4 9	3 50
Vega	7 49	7 31	7 13	6 55	6 37	6 19	6 1	5 43	5 25	5 6	4 47	4 28
α AQUILÆ.	9 0	8 42	8 24	8 6	7 48	7 30	7 12	6 54	6 36	6 17	5 58	5 39
α Pavo.	9 30	9 11	8 53	8 36	8 18	8 0	7 42	7 23	7 5	6 46	6 28	6 9
Deneb	9 54	9 35	9 17	8 59	8 42	8 24	8 5	7 47	7 29	7 10	6 52	6 33
Alderamin .	10 32	10 13	9 56	9 38	9 21	9 3	8 44	8 26	8 8	7 49	7 31	7 12
α Aquarius ..	11 14	10 56	10 38	10 20	10 3	9 45	9 27	9 9	8 50	8 32	8 13	7 54
α Grux	11 14	10 56	10 38	10 20	10 3	9 45	9 27	9 9	8 50	8 32	8 13	7 54
FOMALHAUT	12 5	11 47	11 29	11 11	10 53	10 35	10 17	10 0	9 41	9 23	9 4	8 45
Scheat	12 12	11 54	11 36	11 18	11 0	10 42	10 24	10 6	9 50	9 30	9 11	8 52
MARCAB ...	12 13	11 55	11 37	11 19	11 1	10 43	10 25	10 7	9 50	9 31	9 12	8 53
Alpheratz ..	13 16	12 58	12 40	12 22	12 4	11 46	11 28	11 10	10 52	10 33	10 14	9 55

TABLE XV.

For finding the APPARENT TIME of the PRINCIPAL STARS' passing the MERIDIAN throughout the YEAR.

	November.						December.					
	1	6	11	16	21	26	1	6	11	16	21	26
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
Algenib....	9 37	9 17	8 57	8 38	8 17	7 56	7 34	7 12	6 50	6 28	6 6	5 44
Schedar....	10 3	9 44	9 23	9 3	8 42	8 22	8 1	7 39	7 17	6 55	6 33	6 10
Polar Star .	10 30	10 10	9 50	9 30	9 9	8 48	8 27	8 5	7 44	7 21	6 59	6 37
Mirach	10 33	10 13	9 53	9 32	9 11	8 50	8 30	8 8	7 46	7 24	7 2	6 40
Achernar...	11 4	10 44	10 24	10 4	9 43	9 22	9 0	8 38	8 18	7 55	7 33	7 11
α Arietis ...	11 30	11 10	10 50	10 30	10 9	9 48	9 26	9 5	8 43	8 20	7 59	7 37
Menkar....	12 26	12 6	11 46	11 26	11 5	10 44	10 22	10 0	9 38	9 16	8 54	8 32
Algol	12 29	12 10	11 50	11 29	11 8	10 47	10 26	10 4	9 42	9 20	8 58	8 35
α Perseus ...	12 44	12 25	12 5	11 44	11 23	11 2	10 41	10 19	9 57	9 35	9 13	8 51
Aldebaran	14 0	13 39	13 19	12 58	12 37	12 16	11 55	11 33	11 11	10 49	10 27	10 5
Capella	14 36	14 17	13 57	13 36	13 15	12 54	12 33	12 11	11 49	11 27	11 5	10 42
Rigel......	14 39	14 19	13 59	13 39	13 18	12 57	12 35	12 13	11 51	11 29	11 7	10 45
β Taurus	14 48	14 28	14 8	13 48	13 27	13 6	12 44	12 22	12 0	11 38	11 16	10 54
Bellatrix...	14 48	14 29	14 9	13 48	13 27	13 6	12 45	12 23	12 1	11 39	11 17	10 54
δ Orion......	14 56	14 36	14 16	13 55	13 35	13 13	12 52	12 30	12 8	11 46	11 24	11 2
ε Orion	15 0	14 40	14 20	14 0	13 39	13 18	12 56	12 35	12 13	11 50	11 28	11 6
α Columba...	15 6	14 46	14 26	14 6	13 45	13 24	13 2	12 41	12 19	11 57	11 34	11 12
Betelguese .	15 18	14 58	14 39	14 18	13 57	13 36	13 15	12 53	12 31	12 9	11 47	11 24
Canopus ...	15 52	15 33	15 12	14 53	14 31	14 11	13 49	13 27	13 4	12 44	12 21	11 59
Sirius	16 9	15 49	15 29	15 9	14 48	14 27	14 6	13 45	13 22	13 1	12 38	12 16
Castor	16 55	16 35	16 15	15 55	15 34	15 13	14 51	14 30	14 8	13 46	13 24	13 2
Procyon ...	17 2	16 42	16 22	16 2	15 41	15 20	14 58	14 36	14 14	13 52	13 30	13 9
Pollux....	17 6	16 46	16 26	16 6	15 45	15 24	15 2	14 41	14 19	13 57	13 34	13 13
ξ Argo Navis	17 29	17 9	16 49	16 29	16 8	15 47	15 25	15 4	14 42	14 20	13 57	13 35
γ Argo Navis	17 36	17 16	16 56	16 37	16 15	15 54	15 32	15 10	14 49	14 26	14 4	13 42
δ Argo Navis	18 12	17 52	17 32	17 11	16 51	16 29	16 8	15 46	15 24	15 2	14 40	14 18
β Argo Navis	18 43	18 23	18 3	17 43	17 22	17 1	16 39	16 18	15 56	15 34	15 11	14 49
Alphard....	18 51	18 31	18 11	17 50	17 30	17 8	16 47	16 25	16 3	15 41	15 19	14 57
Regulus...	19 31	19 11	18 51	18 30	18 10	17 48	17 27	17 5	16 43	16 21	15 59	15 37
β Ursa Major	20 23	20 3	19 43	19 23	19 2	18 41	18 19	17 57	17 35	17 13	16 51	16 29
Dubhe	20 24	20 5	19 45	19 24	19 3	18 42	18 21	17 59	17 37	17 15	16 53	16 31
Deneb	21 12	20 52	20 32	20 11	19 51	19 30	19 8	18 46	18 24	18 2	17 40	17 18
γ Ursa Major	21 16	20 56	20 36	20 16	19 55	19 34	19 13	18 51	18 29	18 7	17 45	17 22
α Crux......	21 49	21 28	21 8	20 48	20 26	20 6	19 45	19 22	19 1	18 38	18 17	17 55
γ Crux......	21 53	21 34	21 12	20 53	20 31	20 10	19 49	19 27	19 6	18 43	18 21	17 59
Spica......	22 47	22 27	22 7	21 46	21 26	21 4	20 43	20 21	20 0	19 37	19 15	18 54
Benetnach..	23 12	22 52	22 32	22 11	21 50	21 29	21 8	20 46	20 24	20 2	19 40	19 17
β Centaur ...	23 22	23 2	22 42	22 22	22 1	21 40	21 18	20 57	20 35	20 13	19 50	19 28
α Draco	23 30	23 11	22 51	22 30	22 9	21 48	21 27	21 5	20 43	20 21	19 59	19 37
Arcturus ...	23 38	23 19	22 59	22 38	22 17	21 56	21 35	21 13	20 51	20 29	20 7	19 44
Seginus	23 56	23 36	23 16	22 55	22 35	22 13	21 52	21 30	21 8	20 46	20 24	20 2
α Centaur ...	0 3	23 39	23 19	22 59	22 38	22 17	21 55	21 33	21 12	20 49	20 27	20 5
Zubenesch..	0 16	23 54	23 32	23 11	22 51	22 29	22 8	21 46	21 24	21 2	20 40	20 18
Zubenelg...	0 42	0 23	0 2	23 38	23 17	22 56	22 35	22 13	21 51	21 29	21 7	20 44
Alphacca...	1 2	0 42	0 22	23 58	23 37	23 16	22 54	22 33	22 11	21 48	21 26	21 4
α Serpens....	1 10	0 51	0 31	0 10	23 45	23 24	23 3	22 41	22 19	21 57	21 35	21 12
Antares ..	1 53	1 34	1 13	0 53	0 32	0 11	23 46	23 24	23 2	22 40	22 18	21 55
Ras Algethi	2 41	2 22	2 2	1 41	1 20	0 59	0 38	0 16	23 50	23 28	23 6	22 43
Ras Alhague	3 2	2 42	2 22	2 1	1 40	1 19	0 58	0 36	0 14	23 48	23 26	23 4
Rastaban...	3 26	3 8	2 48	2 27	2 6	1 45	1 24	1 2	0 40	0 18	23 52	23 29
Vega	4 5	3 45	3 25	3 5	2 45	2 23	2 2	1 40	1 18	0 56	0 34	0 12
α Aquilæ....	5 16	4 56	4 36	4 16	3 55	3 34	3 12	2 51	2 30	2 7	1 45	1 23
α Pavo......	5 45	5 26	5 5	4 45	4 24	4 3	3 42	3 20	2 58	2 37	2 15	1 52
Deneb'.....	6 9	5 49	5 29	5 9	4 48	4 27	4 5	3 44	3 22	3 0	2 39	2 16
Alderaimin .	6 48	6 28	6 8	5 48	5 27	5 6	4 44	4 23	4 1	3 39	3 16	2 54
α Aquarius ..	7 30	7 11	6 51	6 30	6 9	5 48	5 27	5 5	4 43	4 21	3 59	3 37
α Grux......	7 31	7 11	6 51	6 30	6 10	5 48	5 27	5 5	4 43	4 21	3 59	3 37
Fomalhaut	8 22	8 2	7 42	7 21	7 0	6 39	6 18	5 56	5 34	5 12	4 50	4 28
Scheat.....	8 29	8 9	7 49	7 29	7 8	6 47	6 25	6 3	5 42	5 19	4 57	4 35
Marcab ...	8 30	8 10	7 50	7 29	7 9	6 47	6 26	6 4	5 42	5 20	4 58	4 36
Alpheratz ..	9 32	9 12	8 53	8 33	8 12	7 51	7 29	7 8	6 46	6 24	6 0	5 39

TABLE XIII.*

To find the LATITUDE by the POLAR STAR

R. A. Merid.	Corr. for 1820.	Corr. for 1830.	R. A. Merid.	Corr. for 1820.	Corr. for 1830.	R. A. Merid.	Corr. for 1820.	Corr. for 1830.	R. A. Merid.	Corr. for 1820.	Corr. for 1830.
h. m.	° ′	° ′	h. m.	° ′	° ′	h. m.	° ′	° ′	h. m.	° ′	° ′
0 0	−1 36	1 33	6 0	−0 24	0 24	12 0	+1 36	1 33	18 0	+0 24	0 24
0 10	−1 37	1 34	6 5	−0 22	0 22	12 10	+1 37	1 34	18 5	+0 22	0 22
0 20	−1 38	1 35	6 10	−0 20	0 20	12 20	+1 38	1 35	18 10	+0 20	0 20
0 30	−1 38	1 35	6 15	−0 18	0 18	12 30	+1 38	1 35	18 15	+0 18	0 18
0 40	−1 39	1 36	6 20	−0 16	0 16	12 40	+1 39	1 36	18 20	+0 16	0 16
0 50	−1 39	1 36	6 25	−0 14	0 14	12 50	+1 39	1 36	18 25	+0 14	0 14
1 0	−1 39	1 36	6 30	−0 12	0 12	13 0	+1 39	1 36	18 30	+0 12	0 12
1 10	−1 39	1 36	6 35	−0 9	0 10	13 10	+1 39	1 36	18 35	+0 9	0 10
1 20	−1 39	1 36	6 40	−0 7	0 8	13 20	+1 39	1 36	18 40	+0 7	0 8
1 30	−1 38	1 35	6 45	−0 5	0 6	13 30	+1 38	1 35	18 45	+0 5	0 6
1 40	−1 37	1 34	6 50	−0 3	0 4	13 40	+1 37	1 34	18 50	+0 3	0 4
1 50	−1 36	1 33	6 55	−0 2	0 2	13 50	+1 36	1 33	18 55	+0 2	0 2
2 0	−1 35	1 32	7 0	+0 1	0 0	14 0	+1 35	1 32	19 0	−0 1	0 0
2 5	−1 35	1 32	7 5	+0 4	0 3	14 5	+1 35	1 32	19 5	−0 4	0 3
2 10	−1 34	1 31	7 10	+0 6	0 4	14 10	+1 34	1 31	19 10	−0 6	0 4
2 15	−1 34	1 31	7 15	+0 8	0 6	14 15	+1 34	1 31	19 15	−0 8	0 6
2 20	−1 33	1 30	7 20	+0 10	0 9	14 20	+1 33	1 30	19 20	−0 10	0 9
2 25	−1 32	1 29	7 25	+0 12	0 11	14 25	+1 32	1 29	19 25	−0 12	0 11
2 30	−1 31	1 28	7 30	+0 14	0 13	14 30	+1 31	1 28	19 30	−0 14	0 13
2 35	−1 30	1 28	7 35	+0 16	0 15	14 35	+1 30	1 28	19 35	−0 16	0 15
2 40	−1 29	1 27	7 40	+0 18	0 17	14 40	+1 29	1 27	19 40	−0 18	0 17
2 45	−1 28	1 26	7 45	+0 20	0 19	14 45	+1 28	1 26	19 45	−0 20	0 19
2 50	−1 27	1 25	7 50	+0 23	0 21	14 50	+1 27	1 25	19 50	−0 23	0 21
2 55	−1 26	1 24	7 55	+0 25	0 23	14 55	+1 26	1 24	19 55	−0 25	0 23
3 0	−1 25	1 23	8 0	+0 27	0 25	15 0	+1 25	1 23	20 0	−0 27	0 25
3 5	−1 24	1 22	8 5	+0 29	0 27	15 5	+1 24	1 22	20 5	−0 29	0 27
3 10	−1 23	1 21	8 10	+0 31	0 29	15 10	+1 23	1 21	20 10	−0 31	0 29
3 15	−1 22	1 20	8 15	+0 33	0 31	15 15	+1 22	1 20	20 15	−0 33	0 31
3 20	−1 20	1 18	8 20	+0 35	0 33	15 20	+1 20	1 18	20 20	−0 35	0 33
3 25	−1 19	1 17	8 25	+0 37	0 35	15 25	+1 19	1 17	20 25	−0 37	0 35
3 30	−1 18	1 16	8 30	+0 39	0 37	15 30	+1 18	1 16	20 30	−0 39	0 37
3 35	−1 17	1 15	8 35	+0 41	0 39	15 35	+1 17	1 15	20 35	−0 41	0 39
3 40	−1 15	1 13	8 40	+0 43	0 41	15 40	+1 15	1 13	20 40	−0 43	0 41
3 45	−1 14	1 12	8 45	+0 45	0 43	15 45	+1 14	1 12	20 45	−0 45	0 43
3 50	−1 12	1 10	8 50	+0 47	0 44	15 50	+1 12	1 10	20 50	−0 47	0 44
3 55	−1 11	1 9	8 55	+0 49	0 46	15 55	+1 11	1 9	20 55	−0 49	0 46
4 0	−1 9	1 7	9 0	+0 51	0 48	16 0	+1 9	1 7	21 0	−0 51	0 48
4 5	−1 8	1 6	9 5	+0 52	0 50	16 5	+1 8	1 6	21 5	−0 52	0 50
4 10	−1 6	1 5	9 10	+0 54	0 52	16 10	+1 6	1 5	21 10	−0 54	0 52
4 15	−1 4	1 3	9 15	+0 56	0 54	16 15	+1 4	1 3	21 15	−0 56	0 54
4 20	−1 3	1 2	9 20	+0 58	0 55	16 20	+1 3	1 2	21 20	−0 58	0 55
4 25	−1 1	1 0	9 25	+1 0	0 57	16 25	+1 1	1 0	21 25	−1 0	0 57
4 30	−0 59	0 58	9 30	+1 1	0 58	16 30	+0 59	0 58	21 30	−1 1	0 58
4 35	−0 58	0 57	9 35	+1 3	1 0	16 35	+0 58	0 57	21 35	−1 3	1 0
4 40	−0 56	0 55	9 40	+1 5	1 2	16 40	+0 56	0 55	21 40	−1 5	1 2
4 45	−0 54	0 53	9 45	+1 6	1 3	16 45	+0 54	0 53	21 45	−1 6	1 3
4 50	−0 52	0 51	9 50	+1 8	1 5	16 50	+0 52	0 51	21 50	−1 8	1 5
4 55	−0 50	0 49	9 55	+1 9	1 6	16 55	+0 50	0 49	21 55	−1 9	1 6
5 0	−0 48	0 47	10 0	+1 11	1 8	17 0	+0 48	0 47	22 0	−1 11	1 8
5 5	−0 46	0 45	10 10	+1 14	1 11	17 5	+0 46	0 45	22 10	−1 14	1 11
5 10	−0 45	0 44	10 20	+1 17	1 14	17 10	+0 45	0 44	22 20	−1 17	1 14
5 15	−0 43	0 42	10 30	+1 19	1 16	17 15	+0 43	0 42	22 30	−1 19	1 16
5 20	−0 41	0 40	10 40	+1 22	1 19	17 20	+0 41	0 40	22 40	−1 22	1 19
5 25	−0 39	0 38	10 50	+1 24	1 21	17 25	+0 39	0 38	22 50	−1 24	1 21
5 30	−0 37	0 36	11 0	+1 26	1 23	17 30	+0 37	0 36	23 0	−1 26	1 23
5 35	−0 35	0 34	11 10	+1 28	1 25	17 35	+0 35	0 34	23 10	−1 28	1 25
5 40	−0 33	0 32	11 20	+1 30	1 27	17 40	+0 33	0 32	23 20	−1 30	1 27
5 45	−0 31	0 31	11 30	+1 32	1 29	17 45	+0 31	0 31	23 30	−1 32	1 29
5 50	−0 29	0 29	11 40	+1 34	1 31	17 50	+0 29	0 29	23 40	−1 34	1 31
5 55	−0 26	0 26	11 50	+1 35	1 32	17 55	+0 26	0 26	23 50	−1 35	1 32

TABLE XIV.*

SUN'S MEAN RIGHT ASCENSION.

Days.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Days.
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	
1	18 46	20 58	22 48	0 42	2 33	4 35	6 40	8 45	10 41	12 29	14 25	16 29	1
2	18 50	21 02	22 52	0 45	2 37	4 40	6 44	8 49	10 44	12 32	14 29	16 33	2
3	18 54	21 06	22 56	0 49	2 40	4 44	6 48	8 52	10 48	12 36	14 33	16 37	3
4	18 59	21 10	22 59	0 53	2 44	4 48	6 52	8 56	10 52	12 40	14 37	16 42	4
5	19 03	21 14	23 03	0 56	2 48	4 52	6 56	9 00	10 55	12 43	14 41	16 46	5
6	19 08	21 18	23 07	1 00	2 52	4 56	7 00	9 04	10 59	12 47	14 45	16 51	6
7	19 12	21 22	23 10	1 04	2 56	5 00	7 04	9 08	11 02	12 51	14 49	16 55	7
8	19 16	21 26	23 14	1 07	3 00	5 04	7 09	9 12	11 06	12 54	14 53	16 59	8
9	19 21	21 30	23 18	1 11	3 04	5 08	7 13	9 15	11 10	12 58	14 57	17 04	9
10	19 25	21 34	23 21	1 15	3 08	5 13	7 17	9 19	11 13	13 02	15 01	17 08	10
11	19 29	21 38	23 25	1 18	3 11	5 17	7 21	9 23	11 17	13 05	15 05	17 13	11
12	19 34	21 42	23 29	1 22	3 15	5 21	7 25	9 27	11 20	13 09	15 09	17 17	12
13	19 38	21 46	23 33	1 26	3 19	5 25	7 29	9 31	11 24	13 13	15 13	17 21	13
14	19 42	21 50	23 36	1 29	3 23	5 29	7 33	9 34	11 28	13 16	15 17	17 26	14
15	19 47	21 54	23 40	1 33	3 27	5 33	7 37	9 38	11 31	13 20	15 21	17 30	15
16	19 51	21 58	23 43	1 37	3 31	5 37	7 41	9 42	11 35	13 24	15 25	17 35	16
17	19 55	22 02	23 47	1 40	3 35	5 42	7 45	9 46	11 38	13 28	15 30	17 39	17
18	20 00	22 05	23 51	1 44	3 39	5 46	7 49	9 49	11 42	13 31	15 34	17 43	18
19	20 04	22 09	23 54	1 48	3 43	5 50	7 53	9 53	11 46	13 35	15 38	17 48	19
20	20 08	22 13	23 58	1 51	3 47	5 54	7 57	9 57	11 49	13 39	15 42	17 52	20
21	20 12	22 17	0 02	1 55	3 51	5 58	8 01	10 00	11 53	13 43	15 46	17 57	21
22	20 17	22 21	0 05	1 59	3 55	6 02	8 05	10 04	11 56	13 46	15 50	18 01	22
23	20 21	22 25	0 09	2 03	3 59	6 07	8 09	10 08	12 00	13 50	15 55	18 06	23
24	20 25	22 28	0 13	2 06	4 03	6 11	8 13	10 12	12 04	13 54	15 59	18 10	24
25	20 29	22 32	0 16	2 10	4 07	6 15	8 17	10 15	12 07	13 58	16 03	18 15	25
26	20 33	22 36	0 20	2 14	4 11	6 19	8 21	10 19	12 11	14 02	16 07	18 19	26
27	20 37	22 40	0 23	2 18	4 15	6 23	8 25	10 23	12 14	14 06	16 12	18 23	27
28	20 42	22 43	0 27	2 21	4 19	6 27	8 29	10 26	12 18	14 09	16 16	18 28	28
29	20 46	22 46	0 31	2 25	4 23	6 31	8 33	10 30	12 22	14 13	16 20	18 32	29
30	20 50		0 34	2 29	4 27	6 36	8 37	10 33	12 25	14 17	16 25	18 37	30
31	20 54		0 38		4 31		8 41	10 37		14 21		18 41	31

TABLE XV.*

For finding the Time of High Water.

Moon's Passage over Merid.	Moon's Semid. 14′ 30″	Moon's Semid. 15′ 30″	Moon's Semid. 16′ 30″	Moon's Passage over Merid.	Moon's Passage over Merid.	Moon's Semid. 14′ 30″	Moon's Semid. 15′ 30″	Moon's Semid. 16′ 30″	Moon's Passage over Merid.
h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
0 0	−0 4	−0 0	+0 5	12 0	6 0	−0 55	−1 2	−1 12	18 0
0 20	−0 8	−0 5	−0 1	12 20	6 20	−0 49	−0 55	−1 3	18 20
0 40	−0 12	−0 10	−0 8	12 40	6 40	−0 43	−0 47	−0 53	18 40
1 0	−0 17	−0 16	−0 15	13 0	7 0	−0 32	−0 34	−0 37	19 0
1 20	−0 22	−0 22	−0 22	13 20	7 20	−0 22	−0 22	−0 22	19 20
1 40	−0 27	−0 28	−0 29	13 40	7 40	−0 11	−0 9	−0 6	19 40
2 0	−0 31	−0 33	−0 36	14 0	8 0	−0 1	+0 3	+0 9	20 0
2 20	−0 36	−0 39	−0 43	14 20	8 20	+0 5	+0 11	+0 19	20 20
2 40	−0 40	−0 44	−0 49	14 40	8 40	+0 11	+0 18	+0 28	20 40
3 0	−0 44	−0 49	−0 55	15 0	9 0	+0 14	+0 22	+0 32	21 0
3 20	−0 48	−0 53	−1 1	15 20	9 20	+0 16	+0 24	+0 36	21 20
3 40	−0 52	−0 58	−1 7	15 40	9 40	+0 16	+0 24	+0 35	21 40
4 0	−0 55	−1 2	−1 12	16 0	10 0	+0 15	+0 23	+0 34	22 0
4 20	−0 57	−1 5	−1 15	16 20	10 20	+0 13	+0 20	+0 31	22 20
4 40	−0 59	−1 7	−1 18	16 40	10 40	+0 11	+0 18	+0 28	22 40
5 0	−1 0	−1 8	−1 19	17 0	11 0	+0 7	+0 14	+0 23	23 0
5 20	−1 0	−1 8	−1 20	17 20	11 20	+0 4	+0 9	+0 17	23 20
5 40	−0 58	−1 5	−1 16	17 40	11 40	0 0	+0 5	+0 11	23 40
6 0	−0 55	−1 2	−1 12	18 0	12 0	−0 4	0 0	+0 5	24 0

TABLE XVI.

For reducing the Time of the Moon's Passage over the Meridian of Greenwich to the Time of its Passage over any other Meridian.

Long.	Daily Variation of the Moon's passing the Meridian.														Time fr. Moon's Southing.
	40 m	42 m	44 m	46 m	48 m	50 m	52 m	54 m	56 m	58 m	60 m	62 m	64 m	66 m	
°	m	m	m	m	m	m	m	m	m	m	m	m	m	m	h. m.
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 0
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0 20
10	1	1	1	1	1	1	1	1	2	2	2	2	2	2	0 40
15	2	2	2	2	2	2	2	2	2	2	2	3	3	3	1 0
20	2	2	2	3	3	3	3	3	3	3	3	3	4	4	1 20
25	3	3	3	3	3	3	4	4	4	4	4	4	4	5	1 40
30	3	3	4	4	4	4	4	4	5	5	5	5	5	5	2 0
35	4	4	4	4	5	5	5	5	5	6	6	6	6	6	2 20
40	4	5	5	5	5	6	6	6	6	6	7	7	7	7	2 40
45	5	5	5	6	6	6	6	7	7	7	7	8	8	8	3 0
50	6	6	6	6	7	7	7	7	8	8	8	9	9	9	3 20
55	6	6	7	7	7	8	8	8	9	9	9	9	10	10	3 40
60	7	7	7	8	8	8	9	9	9	10	10	10	11	11	4 0
65	7	8	8	8	9	9	9	10	10	10	11	11	12	12	4 20
70	8	8	9	9	9	10	10	10	11	11	12	12	12	13	4 40
75	8	9	9	10	10	10	11	11	12	12	12	13	13	14	5 0
80	9	9	10	10	11	11	12	12	12	13	13	14	14	15	5 20
85	9	10	10	11	11	12	12	13	13	14	14	15	15	16	5 40
90	10	10	11	11	12	12	13	13	14	14	15	15	16	16	6 0
95	11	11	12	12	13	13	14	14	15	15	16	16	17	17	6 20
100	11	12	12	13	13	14	14	15	16	16	17	17	18	18	6 40
105	12	12	13	13	14	14	15	16	16	17	17	18	19	19	7 0
110	12	13	13	14	15	15	16	16	17	18	18	19	20	20	7 20
115	13	13	14	15	15	16	17	17	18	19	19	20	20	21	7 40
120	13	14	15	15	16	17	17	18	19	19	20	21	21	22	8 0
125	14	15	15	16	17	17	18	19	19	20	21	22	22	23	8 20
130	14	15	16	17	17	18	19	19	20	21	22	22	23	24	8 40
135	15	16	16	17	18	19	19	20	21	22	22	23	24	25	9 0
140	16	16	17	18	19	19	20	21	22	23	23	24	25	26	9 20
145	16	17	18	19	19	20	21	22	23	23	24	25	26	27	9 40
150	17	17	18	19	20	21	22	22	23	24	25	26	27	27	10 0
155	17	18	19	20	21	22	22	23	24	25	26	27	28	28	10 20
160	18	19	20	20	21	22	23	24	25	26	27	28	28	29	10 40
165	18	19	20	21	22	23	24	25	26	27	27	28	29	30	11 0
170	19	20	21	22	23	24	25	25	26	27	28	29	30	31	11 20
175	19	20	21	22	23	24	25	26	27	28	29	30	31	32	11 40
180	20	21	22	23	24	25	26	27	28	29	30	31	32	33	12 0

TABLE XVII —To correct the Mean Refraction.

App. Alt.	Height of the Thermometer.								
	20°	28°	36°	44°	50°	56°	64°	72°	80°
° ′	add	add	add	add	″	sub	sub	sub	sub
3 0	71″	51″	32″	13″	0	13″	30″	46″	61″
2 30	64	46	29	12	0	12	27	41	55
4 0	58	41	26	11	0	10	24	37	50
4 30	53	38	24	10	0	9	22	34	45
5 0	48	35	22	9	0	9	20	31	40
5 30	45	32	20	9	0	8	19	29	38
6 0	41	30	19	8	0	7	17	26	35
6 30	38	28	17	7	0	7	15	24	33
7 0	36	26	16	7	0	6	14	23	31
7 30	34	25	16	7	0	6	14	22	29
8 0	32	23	15	6	0	5	13	20	27
8 30	30	22	14	6	0	5	12	19	26
9 0	28	20	13	5	0	5	11	18	24
10 0	26	18	12	5	0	4	10	16	22
11 0	23	17	11	5	0	4	9	15	20
12 0	21	15	10	4	0	4	9	13	18
Height of the Barometer.			30.7	30.1	29.6	29.2	28.6		

App. Alt.	Height of the Thermometer.								
	20°	28°	36°	44°	50°	56°	64°	72°	80°
°	add	add	add	add	″	sub	sub	sub	sub
14	18″	13″	8″	4″	0	3″	7″	11″	16″
16	16	12	7	3	0	3	6	10	14
18	14	10	6	3	0	2	6	9	12
20	13	9	6	2	0	2	5	8	11
22	11	8	5	2	0	2	5	7	10
24	10	7	5	2	0	2	4	6	9
26	9	7	4	2	0	2	4	6	8
28	9	6	4	2	0	1	3	5	7
30	8	6	4	2	0	1	3	5	7
35	7	5	3	1	0	1	3	4	6
40	6	4	3	1	0	1	2	3	5
50	4	3	2	1	0	1	2	2	3
60	3	2	1	1	0	0	1	2	2
70	2	1	1	0	0	0	1	1	1
80	1	1	0	0	0	0	0	1	1
90	0	0	0	0	0	0	0	0	0
Height of the Barometer.			30.7	30.1	29.6	29.2	28.6		

TABLE XVIII.

For reducing Moon's Declination to any given Meridian, and to any Time under that Meridian

When ☽'s dec. is increasing, { add in W. Long. sub. in E. Long. } Add corr. for time.

When ☽'s dec. is decreasing, { sub. in W. Long. add in E. Long. } Sub. corr for time

Long.	Variation of the Moon's Declination in twelve Hours.																		Time fr. noon or mid.
	5'	10'	15'	20'	25'	30'	35'	40'	45'	50'	55'	1°0'	1°5'	1°10'	1°15'	1°20'	1°25'	1°30'	
0°	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	0'	h. m.
3	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0 12
6	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	0 24
9	0	0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	0 36
12	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	0 48
15	0	1	1	2	2	2	3	3	4	4	5	5	5	6	6	7	7	7	1 0
18	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	1 12
21	1	1	2	2	3	3	4	5	5	6	6	7	8	8	9	9	10	10	1 24
24	1	1	2	3	3	4	5	5	6	7	7	8	9	9	10	11	11	12	1 36
27	1	1	2	3	4	4	5	6	7	7	8	9	10	10	11	12	13	13	1 48
30	1	2	2	3	4	5	6	7	7	8	9	10	11	12	12	13	14	15	2 0
33	1	2	3	4	5	5	6	7	8	9	10	11	12	13	14	15	16	16	2 12
36	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	2 24
39	1	2	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	2 36
42	1	2	3	5	6	7	8	9	10	12	13	14	15	16	17	19	20	21	2 48
45	1	2	4	5	6	7	9	10	11	12	14	15	16	17	19	20	21	22	3 0
48	1	3	4	5	7	8	9	11	12	13	15	16	17	19	20	21	23	24	3 12
51	1	3	4	6	7	8	10	11	13	14	16	17	18	20	21	23	24	25	3 24
54	1	3	4	6	7	9	10	12	13	15	16	18	19	21	22	24	25	27	3 36
57	2	3	5	6	8	9	11	13	14	16	17	19	21	22	24	25	27	28	3 48
60	2	3	5	7	8	10	12	13	15	17	18	20	22	23	25	27	28	30	4 0
63	2	3	5	7	9	10	12	14	16	17	19	21	23	24	26	28	30	31	4 12
66	2	4	5	7	9	11	13	15	16	18	20	22	24	26	27	29	31	33	4 24
69	2	4	6	8	10	11	13	15	17	19	21	23	25	27	29	31	33	34	4 36
72	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	4 48
75	2	4	6	8	10	12	15	17	19	21	23	25	27	29	31	33	35	37	5 0
78	2	4	6	9	11	13	15	17	19	22	24	26	28	30	32	35	37	39	5 12
81	2	4	7	9	11	13	16	18	20	22	25	27	29	31	34	36	38	40	5 24
84	2	5	7	9	12	14	16	19	21	23	26	28	30	33	35	37	40	42	5 36
87	2	5	7	10	12	14	17	19	22	24	27	29	31	34	36	39	41	43	5 48
90	2	5	7	10	12	15	17	20	22	25	27	30	32	35	37	40	42	45	6 0
93	3	5	8	10	13	15	18	21	23	26	28	31	34	36	39	41	44	46	6 12
96	3	5	8	11	13	16	19	21	24	27	29	32	35	37	40	43	45	48	6 24
99	3	5	8	11	14	16	19	22	25	27	30	33	36	38	41	44	47	49	6 36
102	3	6	8	11	14	17	20	23	25	28	31	34	37	40	42	45	48	51	6 48
105	3	6	9	12	15	17	20	23	26	29	32	35	38	41	44	47	50	52	7 0
108	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	7 12
111	3	6	9	12	15	18	22	25	28	31	34	37	40	43	46	49	52	55	7 24
114	3	6	9	13	16	19	22	25	28	32	35	38	41	44	47	51	54	57	7 36
117	3	6	10	13	16	19	23	26	29	32	36	39	42	45	49	52	55	58	7 48
120	3	7	10	13	17	20	23	27	30	33	37	40	43	47	50	53	57	60	8 0
123	3	7	10	14	17	20	24	27	31	34	38	41	44	48	51	55	58	61	8 12
126	3	7	10	14	17	21	24	28	31	35	38	42	45	49	52	56	59	63	8 24
129	4	7	11	14	18	21	25	29	32	36	39	43	47	50	54	57	61	64	8 36
132	4	7	11	15	18	22	26	29	33	37	40	44	48	51	55	59	62	66	8 48
135	4	7	11	15	19	22	26	30	34	37	41	45	49	52	56	60	64	67	9 0
138	4	8	11	15	19	23	27	31	34	38	42	46	50	54	57	61	65	69	9 12
141	4	8	12	16	20	23	27	31	35	39	43	47	51	55	59	63	67	70	9 24
144	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	9 36
147	4	8	12	16	20	24	29	33	37	41	45	49	53	57	61	65	69	73	9 48
150	4	8	12	17	21	25	29	33	37	42	46	50	54	58	62	67	71	75	10 0
153	4	8	13	17	21	25	30	34	38	42	47	51	55	59	64	68	72	76	10 12
156	4	9	13	17	22	26	30	35	39	43	48	52	56	61	65	69	74	78	10 24
159	4	9	13	18	22	26	31	35	40	44	49	53	57	62	66	71	75	79	10 36
162	4	9	13	18	22	27	31	36	40	45	49	54	58	63	67	72	76	81	10 48
165	5	9	14	18	23	27	32	37	41	46	50	55	60	64	69	73	78	82	11 0
168	5	9	14	19	23	28	33	37	42	47	51	56	61	65	70	75	79	84	11 12
171	5	9	14	19	24	28	33	38	43	47	52	57	62	66	71	76	81	85	11 24
174	5	10	14	19	24	29	34	39	43	48	53	58	63	68	72	77	82	87	11 36
177	5	10	15	20	25	29	34	39	44	49	54	59	64	69	74	79	84	88	11 48
180	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	12 0

TABLE XVIII.

For reducing Moon's Declination to any given Meridian, and to any Time under that Meridian.

When ☽'s dec. is increasing, { add in W. Long. / sub. in E. Long. } Add corr. for time. | When ☽'s dec. is decreasing, { sub. in W. Long. / add in E. Long. } Sub. corr for time

Long.	Variation of the Moon's Declination in twelve Hours.															Time fr. noon or mid.
	1°35′	1°40′	1°45′	1°50′	1°55′	2° 0′	2° 5′	2°10′	2°15′	2°20′	2°25′	2°30′	2°35′	2°40′	2°45′	
0°	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0h 0m
3	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 3	0 3	0 3	0 12
6	0 3	0 3	0 3	0 4	0 4	0 4	0 4	0 4	0 4	0 5	0 5	0 5	0 5	0 5	0 5	0 24
9	0 5	0 5	0 5	0 5	0 6	0 6	0 6	0 6	0 7	0 7	0 7	0 7	0 8	0 8	0 8	0 36
12	0 6	0 7	0 7	0 7	0 8	0 8	0 8	0 9	0 9	0 9	0 10	0 10	0 10	0 11	0 11	0 48
15	0 8	0 8	0 9	0 9	0 10	0 10	0 10	0 11	0 11	0 12	0 12	0 12	0 13	0 13	0 14	1 0
18	0 9	0 10	0 10	0 11	0 11	0 12	0 12	0 13	0 13	0 14	0 14	0 15	0 15	0 16	0 16	1 12
21	0 11	0 12	0 12	0 13	0 13	0 14	0 15	0 15	0 16	0 16	0 17	0 17	0 18	0 19	0 19	1 24
24	0 13	0 13	0 14	0 15	0 15	0 16	0 17	0 17	0 18	0 19	0 19	0 20	0 21	0 21	0 22	1 36
27	0 14	0 15	0 16	0 16	0 17	0 18	0 19	0 19	0 20	0 21	0 22	0 22	0 23	0 24	0 25	1 48
30	0 16	0 17	0 17	0 18	0 19	0 20	0 21	0 22	0 22	0 23	0 24	0 25	0 26	0 27	0 27	2 0
33	0 17	0 18	0 19	0 20	0 21	0 22	0 23	0 24	0 25	0 26	0 27	0 27	0 28	0 29	0 30	2 12
36	0 19	0 20	0 21	0 22	0 23	0 24	0 25	0 26	0 27	0 28	0 29	0 30	0 31	0 32	0 33	2 24
39	0 21	0 22	0 23	0 24	0 25	0 26	0 27	0 28	0 29	0 30	0 31	0 32	0 34	0 35	0 36	2 36
42	0 22	0 23	0 24	0 26	0 27	0 28	0 29	0 30	0 31	0 33	0 34	0 35	0 36	0 37	0 38	2 48
45	0 24	0 25	0 26	0 27	0 29	0 30	0 31	0 32	0 34	0 35	0 36	0 37	0 39	0 40	0 41	3 0
48	0 25	0 27	0 28	0 29	0 31	0 32	0 33	0 35	0 36	0 37	0 39	0 40	0 41	0 43	0 44	3 12
51	0 27	0 28	0 30	0 31	0 33	0 34	0 35	0 37	0 38	0 40	0 41	0 42	0 44	0 45	0 47	3 24
54	0 28	0 30	0 31	0 33	0 34	0 36	0 37	0 39	0 40	0 42	0 43	0 45	0 46	0 48	0 49	3 36
57	0 30	0 32	0 33	0 35	0 36	0 38	0 40	0 41	0 43	0 44	0 46	0 47	0 49	0 51	0 52	3 48
60	0 32	0 33	0 35	0 37	0 38	0 40	0 42	0 43	0 45	0 47	0 48	0 50	0 52	0 53	0 55	4 0
63	0 33	0 35	0 37	0 38	0 40	0 42	0 44	0 45	0 47	0 49	0 51	0 52	0 54	0 56	0 58	4 12
66	0 35	0 37	0 38	0 40	0 42	0 44	0 46	0 48	0 49	0 51	0 53	0 55	0 57	0 59	1 0	4 24
69	0 36	0 38	0 40	0 42	0 44	0 46	0 48	0 50	0 52	0 54	0 56	0 57	0 59	1 1	1 3	4 36
72	0 38	0 40	0 42	0 44	0 46	0 48	0 50	0 52	0 54	0 56	0 58	1 0	1 2	1 4	1 6	4 48
75	0 40	0 42	0 44	0 46	0 48	0 50	0 52	0 54	0 56	0 58	1 0	1 2	1 5	1 7	1 9	5 0
78	0 41	0 43	0 45	0 48	0 50	0 52	0 54	0 56	0 58	1 1	1 3	1 5	1 7	1 9	1 11	5 12
81	0 43	0 45	0 47	0 49	0 52	0 54	0 56	0 58	1 1	1 3	1 5	1 7	1 10	1 12	1 14	5 24
84	0 44	0 47	0 49	0 51	0 54	0 56	0 58	1 1	1 3	1 5	1 8	1 10	1 12	1 15	1 17	5 36
87	0 46	0 48	0 51	0 53	0 56	0 58	1 0	1 3	1 5	1 8	1 10	1 12	1 15	1 17	1 20	5 48
90	0 47	0 50	0 52	0 55	0 57	1 0	1 2	1 5	1 7	1 10	1 12	1 15	1 17	1 20	1 22	6 0
93	0 49	0 52	0 54	0 57	0 59	1 2	1 5	1 7	1 10	1 12	1 15	1 17	1 20	1 23	1 25	6 12
96	0 51	0 53	0 56	0 59	1 1	1 4	1 7	1 9	1 12	1 15	1 17	1 20	1 23	1 25	1 28	6 24
99	0 52	0 55	0 58	1 0	1 3	1 6	1 9	1 11	1 14	1 17	1 20	1 22	1 25	1 28	1 31	6 36
102	0 54	0 57	0 59	1 2	1 5	1 8	1 11	1 14	1 16	1 19	1 22	1 25	1 28	1 31	1 33	6 48
105	0 55	0 58	1 1	1 4	1 7	1 10	1 13	1 16	1 19	1 22	1 25	1 27	1 30	1 33	1 36	7 0
108	0 57	1 0	1 3	1 6	1 9	1 12	1 15	1 18	1 21	1 24	1 27	1 30	1 33	1 36	1 39	7 12
111	0 59	1 2	1 5	1 8	1 11	1 14	1 17	1 20	1 23	1 26	1 29	1 32	1 36	1 39	1 42	7 24
114	1 0	1 3	1 6	1 10	1 13	1 16	1 19	1 22	1 25	1 29	1 32	1 35	1 38	1 41	1 44	7 36
117	1 2	1 5	1 8	1 11	1 15	1 18	1 21	1 24	1 28	1 31	1 34	1 37	1 41	1 44	1 47	7 48
120	1 3	1 7	1 10	1 13	1 17	1 20	1 23	1 27	1 30	1 33	1 37	1 40	1 43	1 47	1 50	8 0
123	1 5	1 8	1 12	1 15	1 19	1 22	1 25	1 29	1 32	1 36	1 39	1 42	1 46	1 49	1 53	8 12
126	1 6	1 10	1 13	1 17	1 20	1 24	1 27	1 31	1 34	1 38	1 41	1 45	1 48	1 52	1 55	8 24
129	1 8	1 12	1 15	1 19	1 22	1 26	1 30	1 33	1 37	1 40	1 44	1 47	1 51	1 55	1 58	8 36
132	1 10	1 13	1 17	1 21	1 24	1 28	1 32	1 35	1 39	1 43	1 46	1 50	1 54	1 57	2 1	8 48
135	1 11	1 15	1 19	1 22	1 26	1 30	1 34	1 37	1 41	1 45	1 49	1 52	1 56	2 0	2 4	9 0
138	1 13	1 17	1 20	1 24	1 28	1 32	1 36	1 40	1 43	1 47	1 51	1 55	1 59	2 3	2 6	9 12
141	1 14	1 18	1 22	1 26	1 30	1 34	1 38	1 42	1 46	1 50	1 54	1 57	2 1	2 5	2 9	9 24
144	1 16	1 20	1 24	1 28	1 32	1 36	1 40	1 44	1 48	1 52	1 56	2 0	2 4	2 8	2 12	9 36
147	1 18	1 22	1 26	1 30	1 34	1 38	1 42	1 46	1 50	1 54	1 58	2 2	2 7	2 11	2 15	9 48
150	1 19	1 23	1 27	1 32	1 36	1 40	1 44	1 48	1 52	1 57	2 1	2 5	2 9	2 13	2 17	10 0
153	1 21	1 25	1 29	1 33	1 38	1 42	1 46	1 50	1 55	1 59	2 3	2 7	2 12	2 16	2 20	10 12
156	1 22	1 27	1 31	1 35	1 40	1 44	1 48	1 53	1 57	2 1	2 6	2 10	2 14	2 19	2 23	10 24
159	1 24	1 28	1 33	1 37	1 42	1 46	1 50	1 55	1 59	2 4	2 8	2 12	2 17	2 21	2 26	10 36
162	1 25	1 30	1 34	1 39	1 43	1 48	1 52	1 57	2 1	2 6	2 10	2 15	2 19	2 24	2 28	10 48
165	1 27	1 32	1 36	1 41	1 45	1 50	1 55	1 59	2 4	2 8	2 13	2 17	2 22	2 27	2 31	11 0
168	1 29	1 33	1 38	1 43	1 47	1 52	1 57	2 1	2 6	2 11	2 15	2 20	2 25	2 29	2 34	11 12
171	1 30	1 35	1 40	1 44	1 49	1 54	1 59	2 3	2 8	2 13	2 18	2 22	2 27	2 32	2 37	11 24
174	1 32	1 37	1 41	1 46	1 51	1 56	2 1	2 6	2 10	2 15	2 20	2 25	2 30	2 35	2 39	11 36
177	1 33	1 38	1 43	1 48	1 53	1 58	2 3	2 8	2 13	2 18	2 23	2 27	2 32	2 37	2 42	11 48
180	1 35	1 40	1 45	1 50	1 55	2 0	2 5	2 10	2 15	2 20	2 25	2 30	2 35	2 40	2 45	12 0

TABLE XVIII.

For reducing Moon's Declination to any given Meridian, and to any Time under that Meridian.

When ☽'s dec. is increasing, { add in W. Long. sub. in E. Long } Add corr. for time. | When ☽'s dec is decreasing, { sub. in W. Long. add in E. Long. } Sub. corr for tim.

Long.	Variation of the Moon's Declination in twelve Hours.													Time fr. noon or mid.
	2° 50′	2° 55	3° 0′	3° 5′	3° 10′	3° 15′	3° 20′	3° 25′	3° 30′	3° 35′	3° 40′	3° 45′	3° 50′	
0°	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0° 0′	0h 0m
3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 4	0 4	0 4	0 4	0 12
6	0 6	0 6	0 6	0 6	0 6	0 6	0 7	0 7	0 7	0 7	0 7	0 7	0 8	0 24
9	0 8	0 9	0 9	0 9	0 9	0 10	0 10	0 10	0 10	0 11	0 11	0 11	0 12	0 36
12	0 11	0 12	0 12	0 12	0 13	0 13	0 13	0 14	0 14	0 14	0 15	0 15	0 16	0 48
15	0 14	0 15	0 15	0 15	0 16	0 16	0 17	0 17	0 17	0 18	0 18	0 19	0 20	1 0
18	0 17	0 17	0 18	0 18	0 19	0 19	0 20	0 20	0 21	0 21	0 22	0 22	0 23	1 12
21	0 20	0 20	0 21	0 22	0 22	0 23	0 23	0 24	0 24	0 25	0 26	0 26	0 27	1 24
24	0 23	0 23	0 24	0 25	0 25	0 26	0 27	0 27	0 28	0 29	0 29	0 30	0 31	1 36
27	0 25	0 26	0 27	0 28	0 28	0 29	0 30	0 31	0 31	0 32	0 33	0 34	0 35	1 48
30	0 28	0 29	0 30	0 31	0 32	0 32	0 33	0 34	0 35	0 36	0 37	0 37	0 39	2 0
33	0 31	0 32	0 33	0 34	0 35	0 36	0 37	0 38	0 38	0 39	0 40	0 41	0 43	2 12
36	0 34	0 35	0 36	0 37	0 38	0 39	0 40	0 41	0 42	0 43	0 44	0 45	0 46	2 24
39	0 37	0 38	0 39	0 40	0 41	0 42	0 43	0 44	0 45	0 47	0 48	0 49	0 50	2 36
42	0 40	0 41	0 42	0 43	0 44	0 45	0 47	0 48	0 49	0 50	0 51	0 52	0 54	2 48
45	0 42	0 44	0 45	0 46	0 47	0 49	0 50	0 51	0 52	0 54	0 55	0 56	0 58	3 0
48	0 45	0 47	0 48	0 49	0 51	0 52	0 53	0 55	0 56	0 57	0 59	1 0	1 2	3 12
51	0 48	0 50	0 51	0 52	0 54	0 55	0 57	0 58	0 59	1 1	1 2	1 4	1 6	3 24
54	0 51	0 52	0 54	0 55	0 57	0 58	1 0	1 1	1 3	1 4	1 6	1 7	1 9	3 36
57	0 54	0 55	0 57	0 59	1 0	1 2	1 3	1 5	1 6	1 8	1 10	1 11	1 13	3 48
60	0 57	0 58	1 0	1 2	1 3	1 5	1 7	1 8	1 10	1 12	1 13	1 15	1 17	4 0
63	0 59	1 1	1 3	1 5	1 6	1 8	1 10	1 12	1 13	1 15	1 17	1 19	1 21	4 12
66	1 2	1 4	1 6	1 8	1 10	1 11	1 13	1 15	1 17	1 19	1 21	1 22	1 25	4 24
69	1 5	1 7	1 9	1 11	1 13	1 15	1 17	1 19	1 20	1 22	1 24	1 26	1 29	4 36
72	1 8	1 10	1 12	1 14	1 16	1 18	1 20	1 22	1 24	1 26	1 28	1 30	1 32	4 48
75	1 11	1 13	1 15	1 17	1 19	1 21	1 23	1 25	1 27	1 30	1 32	1 34	1 36	5 0
78	1 14	1 16	1 18	1 20	1 22	1 24	1 27	1 29	1 31	1 33	1 35	1 37	1 40	5 12
81	1 16	1 19	1 21	1 23	1 25	1 28	1 30	1 32	1 34	1 37	1 39	1 41	1 44	5 24
84	1 19	1 22	1 24	1 26	1 29	1 31	1 33	1 36	1 38	1 40	1 43	1 45	1 48	5 36
87	1 22	1 25	1 27	1 29	1 32	1 34	1 37	1 39	1 41	1 44	1 46	1 49	1 52	5 48
90	1 25	1 27	1 30	1 32	1 35	1 37	1 40	1 42	1 45	1 47	1 50	1 52	1 55	6 0
93	1 28	1 30	1 33	1 36	1 38	1 41	1 43	1 46	1 48	1 51	1 54	1 56	1 59	6 12
96	1 31	1 33	1 36	1 39	1 41	1 44	1 47	1 49	1 52	1 55	1 57	2 0	2 3	6 24
99	1 33	1 36	1 39	1 42	1 44	1 47	1 50	1 53	1 55	1 58	2 1	2 4	2 7	6 36
102	1 36	1 39	1 42	1 45	1 48	1 50	1 53	1 56	1 59	2 2	2 5	2 7	2 11	6 48
105	1 39	1 42	1 45	1 48	1 51	1 54	1 57	2 0	2 2	2 5	2 8	2 11	2 15	7 0
108	1 42	1 45	1 48	1 51	1 54	1 57	2 0	2 3	2 6	2 9	2 12	2 15	2 18	7 12
111	1 45	1 48	1 51	1 54	1 57	2 0	2 3	2 6	2 9	2 13	2 16	2 19	2 22	7 24
114	1 48	1 51	1 54	1 57	2 0	2 3	2 7	2 10	2 13	2 16	2 19	2 22	2 26	7 36
117	1 50	1 54	1 57	2 0	2 3	2 7	2 10	2 13	2 16	2 20	2 23	2 26	2 30	7 48
120	1 53	1 57	2 0	2 3	2 7	2 10	2 13	2 17	2 20	2 23	2 27	2 30	2 34	8 0
123	1 56	2 0	2 3	2 6	2 10	2 13	2 17	2 20	2 23	2 27	2 30	2 34	2 38	8 12
126	1 59	2 2	2 6	2 9	2 13	2 16	2 20	2 23	2 27	2 30	2 34	2 37	2 41	8 24
129	2 2	2 5	2 9	2 13	2 16	2 20	2 23	2 27	2 30	2 34	2 38	2 41	2 45	8 36
132	2 5	2 8	2 12	2 16	2 19	2 23	2 27	2 30	2 34	2 38	2 41	2 45	2 49	8 48
135	2 7	2 11	2 15	2 19	2 22	2 26	2 30	2 34	2 37	2 41	2 45	2 49	2 53	9 0
138	2 10	2 14	2 18	2 22	2 26	2 29	2 33	2 37	2 41	2 45	2 49	2 52	2 57	9 12
141	2 13	2 17	2 21	2 25	2 29	2 33	2 37	2 41	2 44	2 48	2 52	2 56	3 1	9 24
144	2 16	2 20	2 24	2 28	2 32	2 36	2 40	2 44	2 48	2 52	2 56	3 0	3 4	9 36
147	2 19	2 23	2 27	2 31	2 35	2 39	2 43	2 47	2 51	2 56	3 0	3 4	3 8	9 48
150	2 22	2 26	2 30	2 34	2 38	2 42	2 47	2 51	2 55	2 59	3 3	3 7	3 12	10 0
153	2 24	2 29	2 33	2 37	2 41	2 46	2 50	2 54	2 58	3 3	3 7	3 11	3 16	10 12
156	2 27	2 32	2 36	2 40	2 45	2 49	2 53	2 58	3 2	3 6	3 11	3 15	3 20	10 24
159	2 30	2 35	2 39	2 43	2 48	2 52	2 57	3 1	3 5	3 10	3 14	3 19	3 24	10 36
162	2 33	2 37	2 42	2 46	2 51	2 55	3 0	3 4	3 9	3 13	3 18	3 22	3 27	10 48
165	2 36	2 40	2 45	2 50	2 54	2 59	3 3	3 8	3 12	3 17	3 22	3 26	3 31	11 0
168	2 39	2 43	2 48	2 53	2 57	3 2	3 7	3 11	3 16	3 21	3 25	3 30	3 35	11 12
171	2 41	2 46	2 51	2 56	3 0	3 5	3 10	3 15	3 19	3 24	3 29	3 34	3 39	11 24
174	2 44	2 49	2 54	2 59	3 4	3 8	3 13	3 18	3 23	3 28	3 33	3 37	3 43	11 36
177	2 47	2 52	2 57	3 2	3 7	3 12	3 17	3 22	3 26	3 31	3 36	3 41	3 47	11 48
180	2 50	2 55	3 0	3 5	3 10	3 15	3 20	3 25	3 30	3 35	3 40	3 45	3 50	12 0

TABLE XIX.

FOR REDUCING LONGITUDE INTO TIME, AND THE CONTRARY.

°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.
′	m. s.	′	m. s.	′	m. s.	′	m. s.	′	m. s.	′	m. s.
″	s. t.	″	s. t.	″	s. t.	″	s. t.	″	s. t.	″	s. t.
1	0 4	31	2 4	61	4 4	91	6 4	121	8 4	151	10 4
2	0 8	32	2 8	62	4 8	92	6 8	122	8 8	152	10 8
3	0 12	33	2 12	63	4 12	93	6 12	123	8 12	153	10 12
4	0 16	34	2 16	64	4 16	94	6 16	124	8 16	154	10 16
5	0 20	35	2 20	65	4 20	95	6 20	125	8 20	155	10 20
6	0 24	36	2 24	66	4 24	96	6 24	126	8 24	156	10 24
7	0 28	37	2 28	67	4 28	97	6 28	127	8 28	157	10 28
8	0 32	38	2 32	68	4 32	98	6 32	128	8 32	158	10 32
9	0 36	39	2 36	69	4 36	99	6 36	129	8 36	159	10 36
10	0 40	40	2 40	70	4 40	100	6 40	130	8 40	160	10 40
11	0 44	41	2 44	71	4 44	101	6 44	131	8 44	161	10 44
12	0 48	42	2 48	72	4 48	102	6 48	132	8 48	162	10 48
13	0 52	43	2 52	73	4 52	103	6 52	133	8 52	163	10 52
14	0 56	44	2 56	74	4 56	104	6 56	134	8 56	164	10 56
15	1 0	45	3 0	75	5 0	105	7 0	135	9 0	165	11 0
16	1 4	46	3 4	76	5 4	106	7 4	136	9 4	166	11 4
17	1 8	47	3 8	77	5 8	107	7 8	137	9 8	167	11 8
18	1 12	48	3 12	78	5 12	108	7 12	138	9 12	168	11 12
19	1 16	49	3 16	79	5 16	109	7 16	139	9 16	169	11 16
20	1 20	50	3 20	80	5 20	110	7 20	140	9 20	170	11 20
21	1 24	51	3 24	81	5 24	111	7 24	141	9 24	171	11 24
22	1 28	52	3 28	82	5 28	112	7 28	142	9 28	172	11 28
23	1 32	53	3 32	83	5 32	113	7 32	143	9 32	173	11 32
24	1 36	54	3 36	84	5 36	114	7 36	144	9 36	174	11 36
25	1 40	55	3 40	85	5 40	115	7 40	145	9 40	175	11 40
26	1 44	56	3 44	86	5 44	116	7 44	146	9 44	176	11 44
27	1 48	57	3 48	87	5 48	117	7 48	147	9 48	177	11 48
28	1 52	58	3 52	88	5 52	118	7 52	148	9 52	178	11 52
29	1 56	59	3 56	89	5 56	119	7 56	149	9 56	179	11 56
30	2 0	60	4 0	90	6 0	120	8 0	150	10 0	180	12 0

TABLE XX.

FOR FINDING THE DISTANCE OF TERRESTRIAL OBJECTS AT SEA.

Height in feet.	Dist. in miles.	Height in feet.	Dist. in miles.	Height in feet.	Dist. in miles.	Height in feet.	Dist. in miles.	Height in feet.	Dist. in miles.	Height in feet.	Dist. in miles.	Height in feet.	Dist. in miles.
1	1.15	25	5.74	49	8.0	180	15.4	420	23.5	820	32.9	2500	57.4
2	1.62	26	5.86	50	8.1	190	15.8	430	23.8	840	33.3	2600	58.6
3	1.99	27	5.97	55	8.5	200	16.2	440	24.1	860	33.7	2700	59.7
4	2.30	28	6.08	60	8.9	210	16.6	450	24.4	880	34.1	2800	60.8
5	2.57	29	6.18	65	9.3	220	17.0	460	24.6	900	34.5	2900	61.8
6	2.81	30	6.30	70	9.6	230	17.4	470	24.9	920	34.8	3000	63.0
7	3.04	31	6.40	75	9.9	240	17.8	480	25.2	940	35.2	3100	64.0
8	3.25	32	6.50	80	10.3	250	18.2	490	25.4	960	35.6	3200	65.0
9	3.45	33	6.60	85	10.6	260	18.5	500	25.7	980	36.0	3300	66.0
10	3.63	34	6.70	90	10.9	270	18.9	520	26.2	1000	36.3	3400	67.0
11	3.81	35	6.80	95	11.2	280	19.2	540	26.7	1100	38.1	3500	68.0
12	3.98	36	6.90	100	11.5	290	19.6	560	27.2	1200	39.8	3600	69.0
13	4.14	37	6.99	105	11.8	300	19.9	580	27.7	1300	41.4	3700	69.9
14	4.30	38	7.09	110	12.1	310	20.2	600	28.1	1400	43.0	3800	70.9
15	4.45	39	7.17	115	12.3	320	20.6	620	28.6	1500	44.5	3900	71.7
16	4.60	40	7.27	120	12.6	330	20.9	640	29.1	1600	46.0	4000	72.7
17	4.73	41	7.36	125	12.8	340	21.2	660	29.5	1700	47.3	4100	73.6
18	4.87	42	7.44	130	13.1	350	21.5	680	30.0	1800	48.7	4200	74.4
19	5.01	43	7.54	135	13.3	360	21.8	700	30.4	1900	50.1	4300	75.4
20	5.14	44	7.62	140	13.6	370	22.1	720	30.8	2000	51.4	4400	76.2
21	5.26	45	7.70	145	13.8	380	22.4	740	31.2	2100	52.6	4500	77.0
22	5.39	46	7.79	150	14.1	390	22.7	760	31.7	2200	53.9	4700	78.8
23	5.51	47	7.88	160	14.5	400	23.0	780	32.1	2300	55.1	5000	81.2
24	5.62	48	7.96	170	15.0	410	23.3	800	32.5	2400	56.2	1 mile	83.5

TABLE XXI.

For reducing the SUN'S DECLINATION to any given Meridian, and to any Time under that Meridian.

When Sun's dec. is increasing,	add in W. lon. sub. in E. lon.	Add aft. noon. Sub. bef. noon.	When Sun's dec. is decreasing,	sub. in W. lon. add in E. lon.	Sub. aft. noon Add bef. noon.

Long.	SUN'S DECLINATION.												Time fr Noon.
	0°	2°	4°	6°	8°	9°	10°	11°	12°	13°	14°	15°	
0°	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0h 0m
3	0 12	0 12	0 12	0 11	0 11	0 11	0 11	0 11	0 10	0 10	0 9	0 9	0 12
6	0 24	0 24	0 24	0 23	0 23	0 22	0 22	0 21	0 20	0 20	0 18	0 18	0 24
9	0 35	0 35	0 35	0 34	0 34	0 33	0 32	0 32	0 31	0 30	0 28	0 27	0 36
12	0 47	0 47	0 47	0 46	0 45	0 44	0 43	0 42	0 41	0 40	0 38	0 37	0 48
15	0 59	0 59	0 58	0 57	0 56	0 55	0 54	0 53	0 51	0 50	0 48	0 46	1 0
18	1 11	1 10	1 10	1 9	1 7	1 6	1 5	1 3	1 1	1 0	0 58	0 55	1 12
21	1 22	1 22	1 22	1 21	1 18	1 17	1 16	1 14	1 12	1 9	1 7	1 5	1 24
24	1 34	1 34	1 33	1 32	1 29	1 28	1 27	1 24	1 22	1 19	1 17	1 14	1 36
27	1 46	1 45	1 44	1 43	1 41	1 39	1 38	1 35	1 32	1 29	1 27	1 23	1 48
30	1 58	1 57	1 56	1 54	1 51	1 49	1 48	1 45	1 43	1 39	1 36	1 32	2 0
33	2 10	2 10	2 8	2 6	2 3	2 1	1 59	1 55	1 53	1 49	1 46	1 42	2 12
36	2 22	2 21	2 19	2 17	2 14	2 12	2 10	2 6	2 3	1 59	1 56	1 51	2 24
39	2 33	2 32	2 31	2 29	2 25	2 23	2 20	2 16	2 14	2 9	2 5	2 1	2 36
42	2 45	2 44	2 43	2 40	2 36	2 34	2 31	2 27	2 24	2 19	2 15	2 10	2 48
45	2 57	2 56	2 54	2 51	2 47	2 44	2 41	2 38	2 34	2 29	2 24	2 19	3 0
48	3 9	3 8	3 6	3 3	2 59	2 55	2 52	2 49	2 44	2 39	2 34	2 28	3 12
51	3 20	3 19	3 18	3 15	3 10	3 6	3 3	3 0	2 55	2 49	2 44	2 38	3 24
54	3 32	3 31	3 30	3 26	3 21	3 17	3 14	3 10	3 5	2 59	2 53	2 47	3 36
57	3 43	3 42	3 41	3 37	3 32	3 28	3 25	3 21	3 15	3 9	3 3	2 56	3 48
60	3 55	3 54	3 52	3 48	3 43	3 39	3 35	3 31	3 25	3 19	3 13	3 5	4 0
63	4 7	4 6	4 4	4 0	3 54	3 50	3 46	3 42	3 35	3 29	3 22	3 14	4 12
66	4 19	4 18	4 16	4 12	4 5	4 1	3 57	3 52	3 46	3 39	3 32	3 23	4 24
69	4 31	4 30	4 27	4 23	4 16	4 12	4 8	4 3	3 56	3 49	3 42	3 32	4 36
72	4 43	4 42	4 39	4 34	4 27	4 23	4 19	4 13	4 6	3 59	3 51	3 41	4 48
75	4 54	4 53	4 50	4 45	4 38	4 34	4 29	4 23	4 16	4 9	4 1	3 51	5 0
78	5 6	5 5	5 2	4 57	4 50	4 45	4 40	4 34	4 27	4 19	4 11	4 0	5 12
81	5 18	5 17	5 14	5 9	5 1	4 56	4 51	4 44	4 37	4 29	4 20	4 9	5 24
84	5 30	5 28	5 26	5 20	5 12	5 7	5 2	4 55	4 47	4 39	4 30	4 18	5 36
87	5 41	5 40	5 37	5 31	5 23	5 18	5 13	5 5	4 58	4 49	4 40	4 27	5 48
90	5 53	5 52	5 48	5 42	5 34	5 29	5 23	5 16	5 8	4 59	4 49	4 37	6 0
93	6 5	6 4	6 0	5 54	5 46	5 41	5 34	5 27	5 18	5 9	4 59	4 46	6 12
96	6 17	6 15	6 12	6 6	5 57	5 52	5 45	5 37	5 28	5 19	5 9	4 55	6 24
99	6 28	6 27	6 23	6 17	6 8	6 3	5 56	5 48	5 39	5 29	5 18	5 5	6 36
102	6 40	6 39	6 35	6 28	6 19	6 14	6 7	5 58	5 49	5 39	5 28	5 14	6 48
105	6 52	6 51	6 46	6 39	6 30	6 24	6 17	6 9	5 59	5 49	5 37	5 23	7 0
108	7 4	7 2	6 58	6 51	6 41	6 35	6 28	6 19	6 9	5 59	5 47	5 32	7 12
111	7 15	7 14	7 10	7 3	6 52	6 46	6 39	6 30	6 20	6 9	5 56	5 42	7 24
114	7 27	7 26	7 22	7 15	7 3	6 57	6 50	6 40	6 30	6 19	6 6	5 51	7 36
117	7 39	7 37	7 33	7 26	7 14	7 8	7 1	6 51	6 40	6 29	6 15	6 1	7 48
120	7 51	7 49	7 44	7 37	7 25	7 18	7 11	7 1	6 51	6 39	6 25	6 10	8 0
123	8 3	8 1	7 56	7 49	7 37	7 29	7 22	7 12	7 1	6 49	6 35	6 19	8 12
126	8 14	8 13	8 8	8 0	7 48	7 40	7 33	7 22	7 11	6 59	6 44	6 28	8 24
129	8 26	8 24	8 20	8 11	7 59	7 51	7 43	7 33	7 22	7 9	6 54	6 37	8 36
132	8 38	8 36	8 31	8 22	8 10	8 2	7 54	7 43	7 32	7 18	7 4	6 46	8 48
135	8 50	8 48	8 42	8 33	8 21	8 13	8 4	7 54	7 42	7 28	7 13	6 56	9 0
138	9 1	8 59	8 54	8 45	8 33	8 24	8 15	8 5	7 52	7 38	7 23	7 5	9 12
141	9 13	9 11	9 6	8 57	8 44	8 35	8 26	8 15	8 3	7 48	7 33	7 14	9 24
144	9 25	9 23	9 18	9 8	8 55	8 46	8 37	8 26	8 13	7 58	7 42	7 23	9 36
147	9 37	9 35	9 29	9 19	9 6	8 57	8 48	8 36	8 23	8 8	7 52	7 32	9 48
150	9 48	9 45	9 40	9 30	9 17	9 8	8 58	8 47	8 33	8 18	8 2	7 42	10 0
153	10 0	9 57	9 52	9 42	9 28	9 19	9 9	8 57	8 43	8 28	8 12	7 51	10 12
156	10 12	10 9	10 4	9 54	9 39	9 30	9 20	9 8	8 54	8 38	8 21	8 0	10 24
159	10 24	10 21	10 16	10 5	9 50	9 41	9 31	9 18	9 4	8 48	8 31	8 10	10 36
162	10 36	10 33	10 27	10 16	10 1	9 52	9 42	9 29	9 14	8 58	8 41	8 19	10 48
165	10 47	10 44	10 38	10 27	10 12	10 3	9 52	9 39	9 24	9 8	8 50	8 28	11 0
168	10 59	10 56	10 50	10 39	10 24	10 14	10 3	9 50	9 35	9 18	9 0	8 38	11 12
171	11 11	11 8	11 2	10 51	10 35	10 25	10 14	10 0	9 45	9 28	9 10	8 47	11 24
174	11 23	11 20	11 14	11 3	10 46	10 36	10 25	10 11	9 55	9 38	9 19	8 57	11 36
177	11 34	11 31	11 25	11 14	10 57	10 47	10 36	10 21	10 6	9 48	9 29	9 6	11 48
180	11 46	11 43	11 37	11 25	11 8	10 58	10 46	10 32	10 16	9 58	9 38	9 15	12 0

TABLE XXI.

For reducing the SUN'S DECLINATION to any given Meridian, and to any Time under that Meridian.

When Sun's dec. is increasing,	add in W. lon. sub. in E. lon	Add aft. noon. Sub. bef. noon.	When Sun's dec. is decreasing,	sub. in W. lon. add in E. lon.	Sub. aft. noon. Add bef noon

Lon.	SUN'S DECLINATION.														Time f. Noon
	16°	17°	18°	19°	19°30′	20°	20°30′	21°	21°30′	22°	22°30′	23°	23°15′	23°28′	
0°	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0h 0m
3	0 9	0 8	0 8	0 7	0 7	0 6	0 6	0 5	0 5	0 4	0 3	0 2	0 2	0 0	0 12
6	0 18	0 16	0 16	0 14	0 13	0 12	0 11	0 10	0 9	0 8	0 6	0 4	0 4	0 0	0 24
9	0 27	0 24	0 24	0 21	0 20	0 18	0 17	0 15	0 14	0 12	0 10	0 7	0 5	0 0	0 36
12	0 36	0 32	0 31	0 28	0 27	0 25	0 23	0 21	0 19	0 16	0 14	0 9	0 7	0 0	0 48
15	0 44	0 41	0 39	0 35	0 34	0 32	0 29	0 27	0 24	0 21	0 18	0 12	0 9	0 0	1 0
18	0 53	0 49	0 46	0 42	0 40	0 38	0 35	0 32	0 29	0 25	0 21	0 14	0 10	0 0	1 12
21	1 2	0 57	0 54	0 49	0 47	0 44	0 41	0 38	0 34	0 29	0 24	0 17	0 12	0 0	1 24
24	1 11	1 5	1 2	0 56	0 54	0 50	0 47	0 44	0 39	0 34	0 28	0 19	0 14	0 0	1 36
27	1 20	1 14	1 10	1 3	1 1	0 57	0 53	0 50	0 44	0 39	0 32	0 22	0 15	0 0	1 48
30	1 28	1 23	1 18	1 11	1 8	1 4	0 59	0 55	0 49	0 43	0 36	0 25	0 17	0 0	2 0
33	1 37	1 31	1 25	1 18	1 14	1 10	1 4	1 0	0 53	0 47	0 39	0 27	0 19	0 0	2 12
36	1 46	1 39	1 33	1 25	1 21	1 16	1 10	1 5	0 58	0 51	0 42	0 30	0 20	0 0	2 24
39	1 55	1 47	1 41	1 32	1 28	1 22	1 16	1 10	1 3	0 55	0 46	0 32	0 22	0 0	2 36
42	2 4	1 56	1 49	1 39	1 35	1 29	1 22	1 16	1 8	0 59	0 50	0 34	0 24	0 0	2 48
45	2 12	2 5	1 57	1 46	1 42	1 36	1 28	1 22	1 13	1 4	0 54	0 36	0 25	0 0	3 0
48	2 21	2 13	2 4	1 53	1 48	1 42	1 33	1 27	1 18	1 8	0 57	0 39	0 27	0 0	3 12
51	2 30	2 21	2 12	2 0	1 55	1 48	1 39	1 32	1 23	1 12	1 0	0 42	0 29	0 0	3 24
54	2 39	2 29	2 20	2 7	2 2	1 54	1 45	1 38	1 28	1 16	1 3	0 44	0 30	0 0	3 36
57	2 48	2 38	2 28	2 15	2 9	2 1	1 52	1 44	1 33	1 21	1 7	0 47	0 32	0 0	3 48
60	2 56	2 47	2 36	2 23	2 16	2 8	1 59	1 49	1 39	1 26	1 11	0 49	0 34	0 0	4 0
63	3 5	2 55	2 43	2 29	2 22	2 14	2 4	1 54	1 43	1 30	1 14	0 51	0 35	0 0	4 12
66	3 14	3 3	2 51	2 36	2 29	2 20	2 10	1 59	1 48	1 34	1 17	0 54	0 37	0 0	4 24
69	3 23	3 11	2 59	2 43	2 36	2 26	2 16	2 4	1 53	1 38	1 21	0 56	0 39	0 0	4 36
72	3 32	3 19	3 7	2 50	2 43	2 33	2 21	2 10	1 58	1 42	1 25	0 59	0 40	0 0	4 48
75	3 40	3 28	3 15	2 58	2 50	2 40	2 27	2 16	2 3	1 47	1 29	1 1	0 42	0 0	5 0
78	3 49	3 36	3 22	3 5	2 56	2 46	2 33	2 21	2 8	1 51	1 32	1 4	0 44	0 0	5 12
81	3 58	3 44	3 30	3 12	3 3	2 52	2 39	2 26	2 13	1 55	1 35	1 6	0 45	0 0	5 24
84	4 7	3 52	3 38	3 19	3 10	2 58	2 45	2 32	2 18	1 59	1 39	1 9	0 47	0 0	5 36
87	4 16	4 1	3 46	3 26	3 17	3 5	2 52	2 38	2 23	2 4	1 43	1 11	0 49	0 0	5 48
90	4 25	4 10	3 54	3 34	3 24	3 12	2 59	2 44	2 28	2 9	1 47	1 14	0 50	0 0	6 0
93	4 34	4 18	4 1	3 41	3 30	3 18	3 4	2 49	2 32	2 13	1 50	1 16	0 52	0 0	6 12
96	4 43	4 26	4 9	3 48	3 37	3 24	3 9	2 54	2 37	2 17	1 53	1 19	0 54	0 0	6 24
99	4 52	4 34	4 17	3 55	3 44	3 30	3 15	2 59	2 42	2 21	1 57	1 21	0 55	0 0	6 36
102	5 0	4 43	4 25	4 2	3 51	3 37	3 21	3 5	2 47	2 25	2 1	1 24	0 57	0 0	6 48
105	5 8	4 52	4 33	4 9	3 58	3 44	3 27	3 11	2 52	2 30	2 5	1 26	0 59	0 0	7 0
108	5 17	5 0	4 40	4 16	4 4	3 50	3 33	3 16	2 57	2 34	2 9	1 29	1 0	0 0	7 12
111	5 26	5 8	4 48	4 23	4 11	3 56	3 39	3 21	3 2	2 38	2 12	1 31	1 2	0 0	7 24
114	5 35	5 16	4 56	4 30	4 18	4 2	3 46	3 27	3 7	2 43	2 16	1 34	1 4	0 0	7 36
117	5 44	5 25	5 4	4 38	4 25	4 9	3 52	3 33	3 12	2 48	2 20	1 37	1 5	0 0	7 48
120	5 53	5 34	5 12	4 46	4 32	4 16	3 59	3 39	3 17	2 53	2 23	1 39	1 7	0 0	8 0
123	6 2	5 42	5 19	4 53	4 38	4 22	4 4	3 44	3 22	2 57	2 26	1 41	1 9	0 0	8 12
126	6 11	5 50	5 27	5 0	4 45	4 28	4 10	3 49	3 27	3 1	2 29	1 44	1 10	0 0	8 24
129	6 19	5 58	5 35	5 7	4 52	4 34	4 16	3 54	3 32	3 5	2 33	1 46	1 12	0 0	8 36
132	6 28	6 6	5 43	5 14	4 59	4 41	4 22	3 59	3 37	3 9	2 36	1 49	1 14	0 0	8 48
135	6 36	6 15	5 51	5 21	5 6	4 48	4 28	4 5	3 42	3 13	2 40	1 51	1 15	0 0	9 0
138	6 45	6 23	5 58	5 28	5 12	4 54	4 34	4 10	3 47	3 17	2 43	1 54	1 17	0 0	9 12
141	6 54	6 31	6 6	5 35	5 19	5 0	4 40	4 15	3 52	3 21	2 46	1 56	1 19	0 0	9 24
144	7 3	6 39	6 14	5 42	5 26	5 6	4 46	4 21	3 57	3 26	2 50	1 59	1 20	0 0	9 36
147	7 12	6 48	6 22	5 49	5 33	5 13	4 52	4 27	4 2	3 30	2 54	2 1	1 22	0 0	9 48
150	7 21	6 57	6 30	5 57	5 40	5 20	4 58	4 33	4 7	3 35	2 58	2 4	1 24	0 0	10 0
153	7 30	7 5	6 37	6 4	5 46	5 26	5 3	4 38	4 11	3 39	3 1	2 6	1 25	0 0	10 12
156	7 39	7 13	6 45	6 11	5 53	5 32	5 9	4 43	4 16	3 43	3 4	2 9	1 27	0 0	10 24
159	7 48	7 21	6 53	6 18	6 0	5 38	5 15	4 48	4 21	3 47	3 8	2 11	1 29	0 0	10 36
162	7 57	7 29	7 1	6 25	6 7	5 45	5 21	4 54	4 26	3 51	3 12	2 13	1 30	0 0	10 48
165	8 5	7 38	7 9	6 32	6 14	5 52	5 26	5 0	4 31	3 56	3 16	2 15	1 32	0 0	11 0
168	8 14	7 46	7 16	6 39	6 20	5 58	5 32	5 6	4 36	4 0	3 19	2 17	1 34	0 0	11 12
171	8 23	7 54	7 24	6 46	6 27	6 4	5 38	5 11	4 41	4 4	3 22	2 20	1 35	0 0	11 24
174	8 32	8 3	7 32	6 53	6 34	6 10	5 44	5 17	4 46	4 9	3 26	2 22	1 37	0 0	11 36
177	8 41	8 12	7 40	7 1	6 41	6 17	5 51	5 23	4 51	4 14	3 30	2 25	1 39	0 0	11 48
180	8 49	8 21	7 48	7 9	6 48	6 24	5 58	5 29	4 56	4 19	3 34	2 28	1 40	0 0	12 0

TABLE XXII.

To reduce the SUN'S RIGHT ASCENSION to any given Meridian, and to any Time under that Meridian.

{Add in W. long.
Sub. in E. long.}

{Add aft. noon.
Sub. bef. noon.}

Long	SUN'S RIGHT ASCENSION.												Time fr. noon.
	0h.	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	
°	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	h. m
0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
3	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 12
6	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 24
9	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 5	0 36
12	0 7	0 7	0 7	0 8	0 8	0 8	0 8	0 8	0 8	0 8	0 7	0 7	0 48
15	0 9	0 9	0 9	0 10	0 10	0 10	0 10	0 10	0 10	0 10	0 9	0 9	1 0
18	0 11	0 11	0 11	0 12	0 12	0 12	0 12	0 12	0 12	0 11	0 11	0 11	1 12
21	0 13	0 13	0 13	0 14	0 14	0 14	0 14	0 14	0 14	0 13	0 13	0 13	1 24
24	0 15	0 15	0 15	0 15	0 16	0 16	0 17	0 16	0 16	0 15	0 15	0 14	1 36
27	0 16	0 16	0 17	0 17	0 18	0 18	0 19	0 18	0 18	0 17	0 17	0 16	1 48
30	0 18	0 18	0 19	0 19	0 20	0 21	0 21	0 21	0 20	0 19	0 18	0 18	2 0
33	0 20	0 20	0 21	0 21	0 22	0 23	0 23	0 23	0 22	0 21	0 20	0 20	2 12
36	0 22	0 22	0 22	0 23	0 24	0 25	0 25	0 25	0 24	0 23	0 22	0 22	2 24
39	0 24	0 24	0 24	0 25	0 26	0 27	0 27	0 27	0 26	0 25	0 24	0 23	2 36
42	0 25	0 25	0 26	0 27	0 28	0 29	0 29	0 29	0 28	0 27	0 26	0 25	2 48
45	0 27	0 27	0 28	0 29	0 30	0 31	0 31	0 31	0 30	0 29	0 28	0 27	3 0
48	0 29	0 29	0 30	0 31	0 32	0 33	0 33	0 33	0 32	0 31	0 30	0 29	3 12
51	0 31	0 31	0 32	0 33	0 34	0 35	0 35	0 35	0 34	0 33	0 32	0 31	3 24
54	0 33	0 33	0 34	0 35	0 36	0 37	0 37	0 37	0 36	0 35	0 33	0 32	3 36
57	0 35	0 35	0 36	0 37	0 38	0 39	0 39	0 39	0 38	0 36	0 35	0 34	3 48
60	0 36	0 36	0 37	0 39	0 40	0 41	0 42	0 41	0 40	0 38	0 37	0 36	4 0
63	0 38	0 38	0 39	0 41	0 42	0 43	0 44	0 43	0 42	0 40	0 39	0 38	4 12
66	0 40	0 40	0 41	0 43	0 44	0 45	0 46	0 45	0 44	0 42	0 41	0 40	4 24
69	0 42	0 42	0 43	0 45	0 46	0 47	0 48	0 47	0 46	0 44	0 42	0 41	4 36
72	0 44	0 44	0 45	0 46	0 48	0 49	0 50	0 49	0 48	0 46	0 44	0 43	4 48
75	0 45	0 46	0 47	0 48	0 50	0 51	0 52	0 51	0 50	0 48	0 46	0 45	5 0
78	0 47	0 47	0 49	0 50	0 52	0 54	0 54	0 53	0 52	0 50	0 48	0 47	5 12
81	0 49	0 49	0 50	0 52	0 54	0 56	0 56	0 55	0 54	0 52	0 50	0 49	5 24
84	0 51	0 51	0 52	0 54	0 56	0 58	0 58	0 58	0 56	0 54	0 52	0 50	5 36
87	0 53	0 53	0 54	0 56	0 58	1 0	1 0	1 0	0 58	0 56	0 54	0 52	5 48
90	0 54	0 55	0 56	0 58	1 0	1 2	1 2	1 2	1 0	0 58	0 55	0 54	6 0
93	0 56	0 56	0 58	1 0	1 2	1 4	1 4	1 4	1 2	1 0	0 57	0 56	6 12
96	0 58	0 58	1 0	1 2	1 4	1 6	1 6	1 6	1 4	1 2	0 59	0 58	6 24
99	1 0	1 0	1 2	1 4	1 6	1 8	1 9	1 8	1 6	1 3	1 1	0 59	6 36
102	1 2	1 2	1 3	1 6	1 8	1 10	1 11	1 10	1 8	1 5	1 3	1 1	6 48
105	1 4	1 4	1 5	1 8	1 10	1 12	1 13	1 12	1 10	1 7	1 5	1 3	7 0
108	1 5	1 6	1 7	1 10	1 12	1 14	1 15	1 14	1 12	1 9	1 7	1 5	7 12
111	1 7	1 7	1 9	1 12	1 14	1 16	1 17	1 16	1 14	1 11	1 8	1 7	7 24
114	1 9	1 9	1 11	1 14	1 16	1 18	1 19	1 18	1 16	1 13	1 10	1 9	7 36
117	1 11	1 11	1 13	1 16	1 18	1 20	1 21	1 20	1 18	1 15	1 12	1 10	7 48
120	1 13	1 13	1 15	1 17	1 20	1 22	1 23	1 22	1 20	1 17	1 14	1 12	8 0
123	1 14	1 15	1 17	1 19	1 22	1 25	1 25	1 24	1 22	1 19	1 16	1 14	8 12
126	1 16	1 16	1 18	1 21	1 24	1 27	1 27	1 26	1 24	1 21	1 18	1 16	8 24
129	1 18	1 18	1 20	1 23	1 26	1 29	1 29	1 28	1 26	1 23	1 19	1 18	8 36
132	1 20	1 20	1 22	1 25	1 28	1 31	1 31	1 30	1 28	1 25	1 21	1 19	8 48
135	1 22	1 22	1 24	1 27	1 30	1 33	1 34	1 32	1 30	1 26	1 23	1 21	9 0
138	1 24	1 24	1 26	1 29	1 32	1 35	1 36	1 35	1 32	1 28	1 25	1 23	9 12
141	1 26	1 26	1 28	1 31	1 34	1 37	1 38	1 37	1 34	1 30	1 27	1 25	9 24
144	1 27	1 27	1 30	1 33	1 36	1 39	1 40	1 39	1 36	1 32	1 29	1 27	9 36
147	1 29	1 29	1 32	1 35	1 38	1 41	1 42	1 41	1 38	1 34	1 31	1 28	9 48
150	1 31	1 31	1 33	1 37	1 40	1 43	1 44	1 43	1 40	1 36	1 32	1 30	10 0
153	1 33	1 33	1 35	1 39	1 42	1 45	1 46	1 45	1 42	1 38	1 34	1 32	10 12
156	1 34	1 35	1 37	1 41	1 44	1 47	1 48	1 47	1 44	1 40	1 36	1 34	10 24
159	1 36	1 37	1 39	1 43	1 46	1 49	1 50	1 49	1 46	1 42	1 38	1 36	10 36
162	1 38	1 38	1 41	1 45	1 48	1 51	1 52	1 51	1 48	1 44	1 40	1 37	10 48
165	1 40	1 40	1 43	1 46	1 50	1 53	1 54	1 53	1 50	1 46	1 42	1 39	11 0
168	1 42	1 42	1 45	1 48	1 52	1 55	1 56	1 55	1 52	1 48	1 44	1 41	11 12
171	1 44	1 44	1 46	1 50	1 54	1 57	1 59	1 57	1 54	1 49	1 45	1 43	11 24
174	1 45	1 46	1 48	1 52	1 57	2 0	2 1	1 59	1 56	1 51	1 47	1 45	11 36
177	1 47	1 48	1 50	1 54	1 59	2 2	2 3	2 1	1 58	1 53	1 49	1 46	11 48
180	1 49	1 40	1 52	1 56	2 1	2 4	2 5	2 3	2 0	1 55	1 51	1 48	12 0

TABLE XXII.

To reduce the SUN'S RIGHT ASCENSION to any given Meridian, and to any Time under that Meridian.

{Add in W. long. / Sub. in E. long.} {Add aft. noon. / Sub. bef noon}

Long	SUN'S RIGHT ASCENSION.												Time fr. noon.
	12 h.	13 h.	14 h.	15 h.	16 h.	17 h.	18 h.	19 h.	20 h.	21 h.	22 h	23 h.	
°	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s	m. s	h. m.
0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
3	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 12
6	0 4	0 4	0 4	0 4	0 4	0 4	0 5	0 4	0 4	0 4	0 4	0 4	0 24
9	0 5	0 5	0 6	0 6	0 6	0 7	0 7	0 7	0 6	0 6	0 6	0 6	0 36
12	0 7	0 7	0 8	0 8	0 8	0 9	0 9	0 9	0 8	0 8	0 8	0 7	0 48
15	0 9	0 9	0 10	0 10	0 11	0 11	0 11	0 11	0 11	0 10	0 10	0 9	1 0
18	0 11	0 11	0 11	0 12	0 13	0 13	0 13	0 13	0 13	0 12	0 12	0 11	1 12
21	0 13	0 13	0 13	0 14	0 15	0 15	0 16	0 15	0 15	0 14	0 14	0 13	1 24
24	0 14	0 15	0 15	0 16	0 17	0 17	0 18	0 18	0 17	0 16	0 15	0 15	1 36
27	0 16	0 17	0 17	0 18	0 19	0 20	0 20	0 20	0 19	0 18	0 17	0 17	1 48
30	0 18	0 18	0 19	0 20	0 21	0 22	0 22	0 22	0 21	0 20	0 19	0 19	2 0
33	0 20	0 20	0 21	0 22	0 23	0 24	0 24	0 24	0 23	0 22	0 21	0 21	2 12
36	0 22	0 22	0 23	0 24	0 25	0 26	0 27	0 26	0 26	0 24	0 23	0 23	2 24
39	0 23	0 24	0 25	0 26	0 27	0 28	0 29	0 29	0 28	0 26	0 25	0 24	2 36
42	0 25	0 26	0 27	0 28	0 30	0 31	0 31	0 31	0 30	0 28	0 27	0 26	2 48
45	0 27	0 28	0 29	0 30	0 32	0 33	0 33	0 33	0 32	0 30	0 29	0 28	3 0
48	0 29	0 29	0 31	0 32	0 34	0 35	0 35	0 35	0 34	0 32	0 31	0 30	3 12
51	0 31	0 31	0 33	0 34	0 36	0 37	0 38	0 37	0 36	0 35	0 33	0 32	3 24
54	0 32	0 33	0 34	0 36	0 38	0 39	0 40	0 40	0 38	0 37	0 35	0 34	3 36
57	0 34	0 35	0 36	0 38	0 40	0 42	0 42	0 42	0 40	0 39	0 37	0 36	3 48
60	0 36	0 37	0 38	0 40	0 42	0 44	0 44	0 44	0 43	0 41	0 39	0 37	4 0
63	0 38	0 39	0 40	0 42	0 44	0 46	0 47	0 46	0 45	0 43	0 41	0 39	4 12
66	0 40	0 40	0 42	0 44	0 47	0 48	0 49	0 48	0 47	0 45	0 43	0 41	4 24
69	0 41	0 42	0 44	0 46	0 49	0 50	0 51	0 51	0 49	0 47	0 44	0 43	4 36
72	0 43	0 44	0 46	0 48	0 51	0 53	0 53	0 53	0 51	0 49	0 46	0 45	4 48
75	0 45	0 46	0 48	0 50	0 53	0 55	0 56	0 55	0 53	0 51	0 48	0 47	5 0
78	0 47	0 48	0 50	0 52	0 55	0 57	0 58	0 57	0 55	0 53	0 50	0 49	5 12
81	0 49	0 50	0 52	0 54	0 57	0 59	1 0	0 59	0 58	0 55	0 52	0 51	5 24
84	0 50	0 51	0 54	0 56	0 59	1 1	1 2	1 2	1 0	0 57	0 54	0 52	5 36
87	0 52	0 53	0 56	0 59	1 1	1 4	1 4	1 4	1 2	0 59	0 56	0 54	5 48
90	0 54	0 55	0 58	1 1	1 4	1 6	1 7	1 6	1 4	1 1	0 58	0 56	6 0
93	0 56	0 57	0 59	1 3	1 6	1 8	1 9	1 8	1 6	1 3	1 0	0 58	6 12
96	0 58	0 59	1 1	1 5	1 8	1 10	1 11	1 10	1 8	1 5	1 2	1 0	6 24
99	0 59	1 1	1 3	1 7	1 10	1 12	1 13	1 13	1 10	1 7	1 4	1 2	6 36
102	1 1	1 2	1 5	1 9	1 12	1 15	1 16	1 15	1 12	1 9	1 6	1 4	6 48
105	1 3	1 4	1 7	1 11	1 14	1 17	1 18	1 17	1 14	1 11	1 8	1 6	7 0
108	1 5	1 6	1 9	1 13	1 16	1 19	1 20	1 19	1 17	1 13	1 10	1 7	7 12
111	1 7	1 8	1 11	1 15	1 18	1 21	1 22	1 21	1 19	1 15	1 12	1 9	7 24
114	1 8	1 10	1 13	1 17	1 20	1 23	1 24	1 24	1 21	1 17	1 14	1 11	7 36
117	1 10	1 12	1 15	1 19	1 23	1 25	1 27	1 26	1 23	1 19	1 16	1 13	7 48
120	1 12	1 13	1 17	1 21	1 25	1 28	1 29	1 28	1 25	1 21	1 17	1 15	8 0
123	1 14	1 15	1 19	1 23	1 27	1 30	1 31	1 30	1 27	1 23	1 19	1 17	8 12
126	1 16	1 17	1 21	1 25	1 29	1 32	1 33	1 32	1 29	1 25	1 21	1 19	8 24
129	1 17	1 19	1 22	1 27	1 31	1 34	1 36	1 35	1 32	1 27	1 23	1 21	8 36
132	1 19	1 21	1 24	1 29	1 33	1 36	1 38	1 37	1 34	1 29	1 25	1 22	8 48
135	1 21	1 23	1 26	1 31	1 35	1 39	1 40	1 39	1 36	1 31	1 27	1 24	9 0
138	1 23	1 25	1 28	1 33	1 37	1 41	1 42	1 41	1 38	1 33	1 29	1 26	9 12
141	1 25	1 26	1 30	1 35	1 40	1 43	1 44	1 43	1 40	1 36	1 31	1 28	9 24
144	1 26	1 28	1 32	1 37	1 42	1 45	1 47	1 46	1 42	1 38	1 33	1 30	9 36
147	1 28	1 30	1 34	1 39	1 44	1 47	1 49	1 48	1 44	1 40	1 35	1 32	9 48
150	1 30	1 32	1 36	1 41	1 46	1 50	1 51	1 50	1 46	1 42	1 37	1 34	10 0
153	1 32	1 34	1 38	1 43	1 48	1 52	1 53	1 52	1 49	1 44	1 39	1 36	10 12
156	1 34	1 36	1 40	1 45	1 50	1 54	1 56	1 54	1 51	1 46	1 41	1 38	10 24
159	1 35	1 37	1 42	1 47	1 52	1 56	1 58	1 57	1 53	1 48	1 43	1 39	10 36
162	1 37	1 39	1 44	1 49	1 54	1 58	2 0	1 59	1 55	1 50	1 45	1 41	10 48
165	1 39	1 41	1 46	1 51	1 57	2 1	2 2	2 1	1 57	1 52	1 46	1 43	11 0
168	1 41	1 43	1 47	1 53	1 59	2 3	2 4	2 3	1 59	1 54	1 48	1 45	11 12
171	1 43	1 45	1 49	1 55	2 1	2 5	2 7	2 5	2 1	1 56	1 50	1 47	11 24
174	1 44	1 47	1 51	1 57	2 3	2 7	2 9	2 8	2 4	1 58	1 52	1 49	11 36
177	1 46	1 48	1 53	1 59	2 5	2 9	2 11	2 10	2 6	2 0	1 54	1 51	11 48
180	1 48	1 50	1 55	2 1	2 7	2 12	2 13	2 12	2 8	2 2	1 56	1 52	12 0

TABLE XXIII.

LOGARITHMIC SINES, TANGENTS, AND SECANTS, to every Point and Quarter Point of the Compass.

Points.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-sec.	Points.
0	0.000000	10.000000	0.000000	Infinite.	10.000000	Infinite.	8
0 ¼	8.690796	9.999477	8.691319	11.308681	10.000523	11.309204	7 ¾
0 ½	8.991302	9.997904	9.993398	11.006602	10.002096	11.008698	7 ½
0 ¾	9.166520	9.995274	9.171247	10.828753	10.004726	10.833480	7 ¼
1	9.290236	9.991574	9.298662	10.701338	10.008426	10.709764	7
1 ¼	9.385571	9.986786	9.398785	10.601215	10.013214	10.614429	6 ¾
1 ½	9.462824	9.980885	9.481939	10.518061	10.019115	10.537176	6 ½
1 ¾	9.527488	9.973841	9.553647	10.446353	10.026159	10.472512	6 ¼
2	9.582840	9.965615	9.617224	10.382776	10.034385	10.417160	6
2 ¼	9.630992	9.956163	9.674829	10.325171	10.043837	10.369008	5 ¾
2 ½	9.673387	9.945430	9.727957	10.272043	10.054570	10.326613	5 ½
2 ¾	9.711050	9.933350	9.777700	10.222300	10.066650	10.288950	5 ¼
3	9.744739	9.919846	9.824893	10.175107	10.080154	10.255261	5
3 ¼	9.775027	9.904828	9.870199	10.129801	10.095172	10.224973	4 ¾
3 ½	9.802359	9.888185	9.914173	10.085827	10.111815	10.197641	4 ½
3 ¾	9.827084	9.869790	9.957295	10.042705	10.130210	10.172916	4 ¼
4	9.849485	9.849485	10.000000	10.000000	10.150515	10.150515	4
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-sec.	Secant.	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 1——100 Log. 0.000000——2.000000

No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.
1	0.000000	21	1.322219	41	1.612784	61	1.785330	81	1.908485
2	0.301030	22	1.342423	42	1.623249	62	1.792392	82	1.913814
3	0.477121	23	1.361728	43	1.633468	63	1.799341	83	1.919078
4	0.602060	24	1.380211	44	1.643453	64	1.806180	84	1.924279
5	0.698970	25	1.397940	45	1.653213	65	1.812913	85	1.929419
6	0.778151	26	1.414973	46	1.662758	66	1.819544	86	1.934498
7	0.845098	27	1.431364	47	1.672098	67	1.826075	87	1.939519
8	0.903090	28	1.447158	48	1.681241	68	1.832509	88	1.944483
9	0.954243	29	1.462398	49	1.690196	69	1.838849	89	1.949390
10	1.000000	30	1.477121	50	1.698970	70	1.845098	90	1.954243
11	1.041393	31	1.491362	51	1.707570	71	1.851258	91	1.959041
12	1.079181	32	1.505150	52	1.716003	72	1.857332	92	1.963788
13	1.113943	33	1.518514	53	1.724276	73	1.863323	93	1.968483
14	1.146128	34	1.531479	54	1.732394	74	1.869232	94	1.973128
15	1.176091	35	1.544068	55	1.740363	75	1.875061	95	1.977724
16	1.204120	36	1.556302	56	1.748188	76	1.880814	96	1.982271
17	1.230449	37	1.568202	57	1.755875	77	1.886491	97	1.986772
18	1.255273	38	1.579784	58	1.763428	78	1.892095	98	1.991226
19	1.278754	39	1.591065	59	1.770852	79	1.897627	99	1.995635
20	1.301030	40	1.602060	60	1.778151	80	1.903090	100	2.000000

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 1000——1600 Log. 000000——204120

No.	0	1	2	3	4	5	6	7	8	9	Diff.
100	000000	000434	000868	001301	001734	002166	002598	003029	003460	003891	432
101	004321	004751	005180	005609	006038	006466	006894	007321	007748	008174	428
102	008600	009026	009451	009876	010300	010724	011147	011570	011993	012415	424
103	012837	013259	013680	014100	014520	014940	015360	015779	016197	016615	420
104	017033	017451	017868	018284	018700	019116	019532	019947	020361	020775	416
105	021189	021603	022016	022428	022841	023252	023664	024075	024486	024896	412
106	025306	025715	026124	026533	026942	027350	027757	028164	028571	028978	408
107	029384	029789	030195	030600	031004	031408	031812	032216	032619	033021	404
108	033424	033826	034227	034628	035029	035430	035830	036229	036629	037028	400
109	037426	037825	038223	038620	039017	039414	039811	040207	040602	040998	397
110	041393	041787	042182	042575	042969	043362	043755	044148	044540	044931	393
111	045323	045714	046105	046495	046885	047275	047664	048053	048442	048830	390
112	049218	049606	049993	050380	050766	051152	051538	051924	052309	052694	386
113	053078	053463	053846	054230	054613	054996	055378	055760	056142	056524	383
114	056905	057286	057666	058046	058426	058805	059185	059563	059942	060320	379
115	060698	061075	061452	061829	062206	062582	062958	063333	063709	064083	376
116	064458	064832	065206	065580	065953	066326	066699	067071	067443	067814	373
117	068186	068557	068928	069298	069668	070038	070407	070776	071145	071514	370
118	071882	072250	072617	072985	073352	073718	074085	074451	074816	075182	366
119	075547	075912	076276	076640	077004	077368	077731	078094	078457	078819	363
120	079181	079543	079904	080266	080626	080987	081347	081707	082067	082426	360
121	082785	083144	083503	083861	084219	084576	084934	085291	085647	086004	357
122	086360	086716	087071	087426	087781	088136	088490	088845	089198	089552	355
123	089905	090258	090611	090963	091315	091667	092018	092370	092721	093071	352
124	093422	093772	094122	094471	094820	095169	095518	095866	096215	096562	349
125	096910	097257	097604	097951	098297	098644	098990	099335	099681	100026	346
126	100370	100715	101059	101403	101747	102090	102434	102777	103119	103462	343
127	103804	104146	104487	104828	105169	105510	105851	106191	106531	106870	341
128	107210	107549	107888	108227	108565	108903	109241	109578	109916	110253	338
129	110590	110926	111262	111598	111934	112270	112605	112940	113275	113609	335
130	113943	114277	114611	114944	115278	115610	115943	116276	116608	116940	332
131	117271	117603	117934	118265	118595	118926	119256	119586	119915	120245	330
132	120574	120903	121231	121560	121888	122216	122543	122871	123198	123525	328
133	123852	124178	124504	124830	125156	125481	125806	126131	126456	126781	325
134	127105	127429	127752	128076	128399	128722	129045	129368	129690	130012	323
135	130334	130655	130977	131298	131619	131939	132260	132580	132900	133219	321
136	133539	133858	134177	134496	134814	135133	135451	135768	136086	136403	318
137	136721	137037	137354	137670	137987	138303	138618	138934	139249	139564	316
138	139879	140194	140508	140822	141136	141450	141763	142076	142389	142702	314
139	143015	143327	143639	143951	144263	144574	144885	145196	145507	145818	311
140	146128	146438	146748	147058	147367	147676	147985	148294	148603	148911	309
141	149219	149527	149835	150142	150449	150756	151063	151370	151676	151982	307
142	152288	152594	152900	153205	153510	153815	154119	154424	154728	155032	305
143	155336	155640	155943	156246	156549	156852	157154	157457	157759	158061	303
144	158362	158664	158965	159266	159567	159868	160168	160468	160769	161068	300
145	161368	161667	161967	162266	162564	162863	163161	163460	163757	164055	298
146	164353	164650	164947	165244	165541	165838	166134	166430	166726	167022	296
147	167317	167613	167908	168203	168497	168792	169086	169380	169674	169968	294
148	170262	170555	170848	171141	171434	171726	172019	172311	172603	172895	292
149	173186	173478	173769	174060	174351	174641	174932	175222	175512	175802	290
150	176091	176381	176670	176959	177248	177536	177825	178113	178401	178689	288
151	178977	179264	179552	179839	180126	180413	180699	180986	181272	181558	287
152	181844	182129	182415	182700	182985	183270	183554	183839	184123	184407	285
153	184691	184975	185259	185542	185825	186108	186391	186674	186956	187239	283
154	187521	187803	188084	188366	188647	188928	189209	189490	189771	190051	281
155	190332	190612	190892	191171	191451	191730	192010	192289	192567	192846	279
156	193125	193403	193681	193959	194237	194514	194792	195069	195346	195623	278
157	195900	196176	196452	196729	197005	197281	197556	197832	198107	198382	276
158	198657	198932	199206	199481	199755	200029	200303	200577	200850	201124	274
159	201397	201670	201943	202216	202488	202761	203033	203305	203577	203848	272
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 1600——2200 Log. 204120——342423

No.	0	1	2	3	4	5	6	7	8	9	Diff.
160	204120	204391	204662	204933	205204	205475	205745	206016	206286	206556	271
161	206826	207095	207365	207634	207903	208172	208441	208710	208978	209247	269
162	209515	209783	210051	210318	210586	210853	211120	211388	211654	211921	267
163	212188	212454	212720	212986	213252	213518	213783	214049	214314	214579	266
164	214844	215109	215373	215638	215902	216166	216430	216694	216957	217221	264
165	217484	217747	218010	218273	218535	218798	219060	219322	219584	219846	262
166	220108	220370	220631	220892	221153	221414	221675	221936	222196	222456	261
167	222716	222976	223236	223496	223755	224015	224274	224533	224792	225051	259
168	225309	225568	225826	226084	226342	226600	226858	227115	227372	227630	258
169	227887	228144	228400	228657	228913	229170	229426	229682	229938	230193	256
170	230449	230704	230960	231215	231470	231724	231979	232233	232488	232742	255
171	232996	233250	233504	233757	234011	234264	234517	234770	235023	235276	253
172	235528	235781	236033	236285	236537	236789	237041	237292	237544	237795	252
173	238046	238297	238548	238799	239049	239299	239550	239800	240050	240300	250
174	240549	240799	241048	241297	241546	241795	242044	242293	242541	242790	249
175	243038	243286	243534	243782	244030	244277	244524	244772	245019	245266	247
176	245513	245759	246006	246252	246499	246745	246991	247236	247482	247728	246
177	247973	248219	248464	248709	248954	249198	249443	249687	249932	250176	245
178	250420	250664	250908	251151	251395	251638	251881	252125	252367	252610	243
179	252853	253096	253338	253580	253822	254064	254306	254548	254790	255031	242
180	255273	255514	255755	255996	256236	256477	256718	256958	257198	257439	241
181	257679	257918	258158	258398	258637	258877	259116	259355	259594	259833	239
182	260071	260310	260548	260787	261025	261263	261501	261738	261976	262214	238
183	262451	262688	262925	263162	263399	263636	263873	264109	264345	264582	237
184	264818	265054	265290	265525	265761	265996	266232	266467	266702	266937	235
185	267172	267406	267641	267875	268110	268344	268578	268812	269046	269279	234
186	269513	269746	269980	270213	270446	270679	270912	271144	271377	271609	233
187	271842	272074	272306	272538	272770	273001	273233	273464	273696	273927	232
188	274158	274389	274620	274850	275081	275311	275542	275772	276002	276232	230
189	276462	276691	276921	277151	277380	277609	277838	278067	278296	278525	229
190	278754	278982	279210	279439	279667	279895	280123	280351	280578	280806	228
191	281033	281261	281488	281715	281942	282169	282395	282622	282849	283075	227
192	283301	283527	283753	283979	284205	284431	284656	284882	285107	285332	226
193	285557	285782	286007	286232	286456	286681	286905	287130	287354	287578	225
194	287802	288025	288249	288473	288696	288920	289143	289366	289589	289812	223
195	290035	290257	290480	290702	290925	291147	291369	291591	291813	292034	222
196	292256	292478	292699	292920	293141	293363	293583	293804	294025	294246	221
197	294466	294687	294907	295127	295347	295567	295787	296007	296226	296446	220
198	296665	296884	297104	297323	297542	297761	297979	298198	298416	298635	219
199	298853	299071	299289	299507	299725	299943	300161	300378	300595	300813	218
200	301030	301247	301464	301681	301898	302114	302331	302547	302764	302980	217
201	303196	303412	303628	303844	304059	304275	304491	304706	304921	305136	216
202	305351	305566	305781	305996	306211	306425	306639	306854	307068	307282	214
203	307496	307710	307924	308137	308351	308564	308778	308991	309204	309417	213
204	309630	309843	310056	310268	310481	310693	310906	311118	311330	311542	212
205	311754	311966	312177	312389	312600	312812	313023	313234	313445	313656	211
206	313867	314078	314289	314499	314710	314920	315130	315340	315550	315760	210
207	315970	316180	316390	316599	316809	317018	317227	317436	317645	317854	209
208	318063	318272	318481	318689	318898	319106	319314	319522	319730	319938	208
209	320146	320354	320562	320769	320977	321184	321391	321598	321805	322012	207
210	322219	322426	322633	322839	323046	323252	323458	323665	323871	324077	206
211	324282	324488	324694	324899	325105	325310	325516	325721	325926	326131	205
212	326336	326541	326745	326950	327155	327359	327563	327767	327972	328176	204
213	328380	328583	328787	328991	329194	329398	329601	329805	330008	330211	203
214	330414	330617	330819	331022	331225	331427	331630	331832	332034	332236	202
215	332438	332640	332842	333044	333246	333447	333649	333850	334051	334253	202
216	334454	334655	334856	335056	335257	335458	335658	335859	336059	336260	201
217	336460	336660	336860	337060	337260	337459	337659	337858	338058	338257	200
218	338456	338656	338855	339054	339253	339451	339650	339849	340047	340246	199
219	340444	340642	340841	341039	341237	341435	341632	341830	342028	342225	198
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV

LOGARITHMS OF NUMBERS.

No. 2200——2800 Log. 342423——447158

No.	0	1	2	3	4	5	6	7	8	9	Diff.
220	342423	342620	342817	343014	343212	343409	343606	343802	343999	344196	197
221	344392	344589	344785	344981	345178	345374	345570	345766	345962	346157	196
222	346353	346549	346744	346939	347135	347330	347525	347720	347915	348110	195
223	348305	348500	348694	348889	349083	349278	349472	349666	349860	350054	194
224	350248	350442	350636	350829	351023	351216	351410	351603	351796	351989	193
225	352182	352375	352568	352761	352954	353147	353339	353532	353724	353916	193
226	354108	354301	354493	354685	354876	355068	355260	355452	355643	355834	192
227	356026	356217	356408	356599	356790	356981	357172	357363	357554	357744	191
228	357935	358125	358316	358506	358696	358886	359076	359266	359456	359646	190
229	359835	360025	360215	360404	360593	360783	360972	361161	361350	361539	189
230	361728	361917	362105	362294	362482	362671	362859	363048	363236	363424	188
231	363612	363800	363988	364176	364363	364551	364739	364926	365113	365301	188
232	365488	365675	365862	366049	366236	366423	366610	366796	366983	367169	187
233	367356	367542	367729	367915	368101	368287	368473	368659	368844	369030	186
234	369216	369401	369587	369772	369958	370143	370328	370513	370698	370883	185
235	371068	371253	371437	371622	371806	371991	372175	372360	372544	372728	184
236	372912	373096	373280	373464	373647	373831	374015	374198	374382	374565	184
237	374748	374932	375115	375298	375481	375664	375846	376029	376212	376394	183
238	376577	376759	376942	377124	377306	377488	377670	377852	378034	378216	182
239	378398	378580	378761	378943	379124	379306	379487	379668	379849	380030	181
240	380211	380392	380573	380754	380934	381115	381296	381476	381656	381837	181
241	382017	382197	382377	382557	382737	382917	383097	383277	383456	383636	180
242	383815	383995	384174	384353	384533	384712	384891	385070	385249	385428	179
243	385606	385785	385964	386142	386321	386499	386677	386856	387034	387212	178
244	387390	387568	387746	387923	388101	388279	388456	388634	388811	388989	178
245	389166	389343	389520	389697	389875	390051	390228	390405	390582	390759	177
246	390935	391112	391288	391464	391641	391817	391993	392169	392345	392521	176
247	392697	392873	393048	393224	393400	393575	393751	393926	394101	394277	176
248	394452	394627	394802	394977	395152	395326	395501	395676	395850	396025	175
249	396199	396374	396548	396722	396896	397071	397245	397418	397592	397766	174
250	397940	398114	398287	398461	398634	398808	398981	399154	399327	399501	173
251	399674	399847	400020	400192	400365	400538	400711	400883	401056	401228	173
252	401400	401573	401745	401917	402089	402261	402433	402605	402777	402949	172
253	403120	403292	403464	403635	403807	403978	404149	404320	404492	404663	171
254	404834	405005	405175	405346	405517	405688	405858	406029	406199	406370	171
255	406540	406710	406881	407051	407221	407391	407561	407731	407900	408070	170
256	408240	408410	408579	408749	408918	409087	409257	409426	409595	409764	169
257	409933	410102	410271	410440	410608	410777	410946	411114	411283	411451	169
258	411620	411788	411956	412124	412292	412460	412628	412796	412964	413132	168
259	413300	413467	413635	413802	413970	414137	414305	414472	414639	414806	167
260	414973	415140	415307	415474	415641	415808	415974	416141	416308	416474	167
261	416640	416807	416973	417139	417306	417472	417638	417804	417970	418135	166
262	418301	418467	418633	418798	418964	419129	419295	419460	419625	419791	165
263	419956	420121	420286	420451	420616	420781	420945	421110	421275	421439	165
264	421604	421768	421933	422097	422261	422426	422590	422754	422918	423082	164
265	423246	423410	423573	423737	423901	424064	424228	424392	424555	424718	164
266	424882	425045	425208	425371	425534	425697	425860	426023	426186	426349	163
267	426511	426674	426836	426999	427161	427324	427486	427648	427811	427973	162
268	428135	428297	428459	428621	428782	428944	429106	429268	429429	429591	162
269	429752	429914	430075	430236	430398	430559	430720	430881	431042	431203	161
270	431364	431525	431685	431846	432007	432167	432328	432488	432649	432809	160
271	432969	433129	433290	433450	433610	433770	433930	434090	434249	434409	160
272	434569	434728	434888	435048	435207	435366	435526	435685	435844	436003	159
273	436163	436322	436481	436640	436798	436957	437116	437275	437433	437592	159
274	437751	437909	438067	438226	438384	438542	438700	438859	439017	439175	158
275	439333	439491	439648	439806	439964	440122	440279	440437	440594	440752	158
276	440909	441066	441224	441381	441538	441695	441852	442009	442166	442323	157
277	442480	442636	442793	442950	443106	443263	443419	443576	443732	443888	157
278	444045	444201	444357	444513	444669	444825	444981	445137	445293	445448	156
279	445604	445760	445915	446071	446226	446382	446537	446692	446848	447003	155
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 2800——3400 Log. 447158——531479

No.	0	1	2	3	4	5	6	7	8	9	Diff.
280	447158	447313	447468	447623	447778	447933	448088	448242	448397	448552	155
281	448706	448861	449015	449170	449324	449478	449633	449787	449941	450095	154
282	450249	450403	450557	450711	450865	451018	451172	451326	451479	451633	154
283	451786	451940	452093	452247	452400	452553	452706	452859	453012	453165	153
284	453318	453471	453624	453777	453930	454082	454235	454387	454540	454692	153
285	454845	454997	455149	455302	455454	455606	455758	455910	456062	456214	152
286	456366	456518	456670	456821	456973	457125	457276	457428	457579	457730	152
287	457882	458033	458184	458336	458487	458638	458789	458940	459091	459242	151
288	459392	459543	459694	459845	459995	460146	460296	460447	460597	460747	151
289	460898	461048	461198	461348	461498	461649	461799	461948	462098	462248	150
290	462398	462548	462697	462847	462997	463146	463296	463445	463594	463744	150
291	463893	464042	464191	464340	464489	464639	464787	464936	465085	465234	149
292	465383	465532	465680	465829	465977	466126	466274	466423	466571	466719	149
293	466868	467016	467164	467312	467460	467608	467756	467904	468052	468200	148
294	468347	468495	468643	468790	468938	469085	469233	469380	469527	469675	148
295	469822	469969	470116	470263	470410	470557	470704	470851	470998	471145	147
296	471292	471438	471585	471732	471878	472025	472171	472317	472464	472610	147
297	472756	472903	473049	473195	473341	473487	473633	473779	473925	474070	146
298	474216	474362	474508	474653	474799	474944	475090	475235	475381	475526	146
299	475671	475816	475962	476107	476252	476397	476542	476687	476832	476976	145
300	477121	477266	477411	477555	477700	477844	477989	478133	478278	478422	145
301	478566	478711	478855	478999	479143	479287	479431	479575	479719	479863	144
302	480007	480151	480294	480438	480582	480725	480869	481012	481156	481299	144
303	481443	481586	481729	481872	482016	482159	482302	482445	482588	482731	143
304	482874	483016	483159	483302	483445	483587	483730	483872	484015	484157	143
305	484300	484442	484584	484727	484869	485011	485153	485295	485437	485579	142
306	485721	485863	486005	486147	486289	486430	486572	486714	486855	486997	142
307	487138	487280	487421	487563	487704	487845	487986	488127	488269	488410	141
308	488551	488692	488833	488973	489114	489255	489396	489537	489677	489818	141
309	489958	490099	490239	490380	490520	490661	490801	490941	491081	491222	140
310	491362	491502	491642	491782	491922	492062	492201	492341	492481	492621	140
311	492760	492900	493040	493179	493319	493458	493597	493737	493876	494015	139
312	494155	494294	494433	494572	494711	494850	494989	495128	495267	495406	139
313	495544	495683	495822	495960	496099	496237	496376	496514	496653	496791	139
314	496930	497068	497206	497344	497482	497621	497759	497897	498035	498173	138
315	498311	498448	498586	498724	498862	498999	499137	499275	499412	499550	138
316	499687	499824	499962	500099	500236	500374	500511	500648	500785	500922	137
317	501059	501196	501333	501470	501607	501744	501880	502017	502154	502290	137
318	502427	502564	502700	502837	502973	503109	503246	503382	503518	503654	136
319	503791	503927	504063	504199	504335	504471	504607	504743	504878	505014	136
320	505150	505286	505421	505557	505692	505828	505963	506099	506234	506370	136
321	506505	506640	506775	506911	507046	507181	507316	507451	507586	507721	135
322	507856	507991	508125	508260	508395	508530	508664	508799	508933	509068	135
323	509202	509337	509471	509606	509740	509874	510008	510143	510277	510411	134
324	510545	510679	510813	510947	511081	511215	511348	511482	511616	511750	134
325	511883	512017	512150	512284	512417	512551	512684	512818	512951	513084	133
326	513218	513351	513484	513617	513750	513883	514016	514149	514282	514415	133
327	514548	514680	514813	514946	515079	515211	515344	515476	515609	515741	133
328	515874	516006	516139	516271	516403	516535	516668	516800	516932	517064	132
329	517196	517328	517460	517592	517724	517855	517987	518119	518251	518382	132
330	518514	518645	518777	518909	519040	519171	519303	519434	519565	519697	131
331	519828	519959	520090	520221	520352	520483	520614	520745	520876	521007	131
332	521138	521269	521400	521530	521661	521792	521922	522053	522183	522314	131
333	522444	522575	522705	522835	522966	523096	523226	523356	523486	523616	130
334	523746	523876	524006	524136	524266	524396	524526	524656	524785	524915	130
335	525045	525174	525304	525434	525563	525693	525822	525951	526081	526210	129
336	526339	526468	526598	526727	526856	526985	527114	527243	527372	527501	129
337	527630	527759	527888	528016	528145	528274	528402	528531	528660	528788	129
338	528917	529045	529174	529302	529430	529559	529687	529815	529943	530072	128
339	530200	530328	530456	530584	530712	530840	530968	531095	531223	531351	128
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 3400——4000 Log. 531479——602060

No.	0	1	2	3	4	5	6	7	8	9	Diff.
340	531479	531607	531734	531862	531990	532117	532245	532372	532500	532627	128
341	532754	532882	533009	533136	533263	533391	533518	533645	533772	533899	127
342	534026	534153	534280	534407	534534	534661	534787	534914	535041	535167	127
343	535294	535421	535547	535674	535800	535927	536053	536179	536306	536432	126
344	536558	536685	536811	536937	537063	537189	537315	537441	537567	537693	126
345	537819	537945	538071	538197	538322	538448	538574	538699	538825	538951	126
346	539076	539202	539327	539452	539578	539703	539829	539954	540079	540204	125
347	540329	540455	540580	540705	540830	540955	541080	541205	541330	541454	125
348	541579	541704	541829	541953	542078	542203	542327	542452	542576	542701	125
349	542825	542950	543074	543199	543323	543447	543571	543696	543820	543944	124
350	544068	544192	544316	544440	544564	544688	544812	544936	545060	545183	124
351	545307	545431	545554	545678	545802	545925	546049	546172	546296	546419	124
352	546543	546666	546789	546913	547036	547159	547282	547405	547529	547652	123
353	547775	547898	548021	548144	548266	548389	548512	548635	548758	548881	123
354	549003	549126	549249	549371	549494	549616	549739	549861	549984	550106	123
355	550228	550351	550473	550595	550717	550840	550962	551084	551206	551328	122
356	551450	551572	551694	551816	551938	552059	552181	552303	552425	552546	122
357	552668	552790	552911	553033	553154	553276	553398	553519	553640	553762	121
358	553883	554004	554126	554247	554368	554489	554610	554731	554852	554973	121
359	555094	555215	555336	555457	555578	555699	555820	555940	556061	556182	121
360	556302	556423	556544	556664	556785	556905	557026	557146	557267	557387	120
361	557507	557627	557748	557868	557988	558108	558228	558348	558469	558589	120
362	558709	558829	558948	559068	559188	559308	559428	559548	559667	559787	120
363	559907	560026	560146	560265	560385	560504	560624	560743	560863	560982	119
364	561101	561221	561340	561459	561578	561698	561817	561936	562055	562174	119
365	562293	562412	562531	562650	562769	562887	563006	563125	563244	563362	119
366	563481	563600	563718	563837	563955	564074	564192	564311	564429	564548	119
367	564666	564784	564903	565021	565139	565257	565376	565494	565612	565730	118
368	565848	565966	566084	566202	566320	566437	566555	566673	566791	566909	118
369	567026	567144	567262	567379	567497	567614	567732	567849	567967	568084	118
370	568202	568319	568436	568554	568671	568788	568905	569023	569140	569257	117
371	569374	569491	569608	569725	569842	569959	570076	570193	570309	570426	117
372	570543	570660	570776	570893	571010	571126	571243	571359	571476	571592	117
373	571709	571825	571942	572058	572174	572291	572407	572523	572639	572755	116
374	572872	572988	573104	573220	573336	573452	573568	573684	573800	573915	116
375	574031	574147	574263	574379	574494	574610	574726	574841	574957	575072	116
376	575188	575303	575419	575534	575650	575765	575880	575996	576111	576226	115
377	576341	576457	576572	576687	576802	576917	577032	577147	577262	577377	115
378	577492	577607	577721	577836	577951	578066	578181	578295	578410	578525	115
379	578639	578754	578868	578983	579097	579212	579326	579441	579555	579669	114
380	579784	579898	580012	580126	580240	580355	580469	580583	580697	580811	114
381	580925	581039	581153	581267	581381	581495	581608	581722	581836	581950	114
382	582063	582177	582291	582404	582518	582631	582745	582858	582972	583085	114
383	583199	583312	583426	583539	583652	583765	583879	583992	584105	584218	113
384	584331	584444	584557	584670	584783	584896	585009	585122	585235	585348	113
385	585461	585574	585686	585799	585912	586024	586137	586250	586362	586475	113
386	586587	586700	586812	586925	587037	587149	587262	587374	587486	587599	112
387	587711	587823	587935	588047	588160	588272	588384	588496	588608	588720	112
388	588832	588944	589056	589167	589279	589391	589503	589615	589726	589838	112
389	589950	590061	590173	590284	590396	590507	590619	590730	590842	590953	112
390	591065	591176	591287	591399	591510	591621	591732	591843	591955	592066	111
391	592177	592288	592399	592510	592621	592732	592843	592954	593064	593175	111
392	593286	593397	593508	593618	593729	593840	593950	594061	594171	594282	111
393	594393	594503	594613	594724	594834	594945	595055	595165	595276	595386	110
394	595496	595606	595717	595827	595937	596047	596157	596267	596377	596487	110
395	596597	596707	596817	596927	597037	597146	597256	597366	597476	597585	110
396	597695	597805	597914	598024	598134	598243	598353	598462	598572	598681	110
397	598790	598900	599009	599119	599228	599337	599446	599556	599665	599774	109
398	599883	599992	600101	600210	600319	600428	600537	600646	600755	600864	109
399	600973	601082	601190	601299	601408	601517	601625	601734	601843	601951	109
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 4000——4600 Log. 602060——662758

No.	0	1	2	3	4	5	6	7	8	9	Diff.
400	602060	602169	602277	602386	602494	602603	602711	602819	602928	603036	108
401	603144	603253	603361	603469	603577	603686	603794	603902	604010	604118	108
402	604226	604334	604442	604550	604658	604766	604874	604982	605089	605197	108
403	605305	605413	605521	605628	605736	605844	605951	606059	606166	606274	108
404	606381	606489	606596	606704	606811	606919	607026	607133	607241	607348	107
405	607455	607562	607669	607777	607884	607991	608098	608205	608312	608419	107
406	608526	608633	608740	608847	608954	609061	609167	609274	609381	609488	107
407	609594	609701	609808	609914	610021	610128	610234	610341	610447	610554	107
408	610660	610767	610873	610979	611086	611192	611298	611405	611511	611617	106
409	611723	611829	611936	612042	612148	612254	612360	612466	612572	612678	106
410	612784	612890	612996	613101	613207	613313	613419	613525	613630	613736	106
411	613842	613947	614053	614159	614264	614370	614475	614581	614686	614792	106
412	614897	615003	615108	615213	615319	615424	615529	615634	615740	615845	105
413	615950	616055	616160	616265	616370	616475	616580	616685	616790	616895	105
414	617000	617105	617210	617315	617420	617524	617629	617734	617839	617943	105
415	618048	618153	618257	618362	618466	618571	618675	618780	618884	618989	105
416	619093	619198	619302	619406	619511	619615	619719	619823	619928	620032	104
417	620136	620240	620344	620448	620552	620656	620760	620864	620968	621072	104
418	621176	621280	621384	621488	621592	621695	621799	621903	622007	622110	104
419	622214	622318	622421	622525	622628	622732	622835	622939	623042	623146	104
420	623249	623353	623456	623559	623663	623766	623869	623972	624076	624179	103
421	624282	624385	624488	624591	624694	624798	624901	625004	625107	625209	103
422	625312	625415	625518	625621	625724	625827	625929	626032	626135	626238	103
423	626340	626443	626546	626648	626751	626853	626956	627058	627161	627263	103
424	627366	627468	627571	627673	627775	627878	627980	628082	628184	628287	102
425	628389	628491	628593	628695	628797	628900	629002	629104	629206	629308	102
426	629410	629511	629613	629715	629817	629919	630021	630123	630224	630326	102
427	630428	630530	630631	630733	630834	630936	631038	631139	631241	631342	102
428	631444	631545	631647	631748	631849	631951	632052	632153	632255	632356	101
429	632457	632558	632660	632761	632862	632963	633064	633165	633266	633367	101
430	633468	633569	633670	633771	633872	633973	634074	634175	634276	634376	101
431	634477	634578	634679	634779	634880	634981	635081	635182	635283	635383	101
432	635484	635584	635685	635785	635886	635986	636086	636187	636287	636388	100
433	636488	636588	636688	636789	636889	636989	637089	637189	637289	637390	100
434	637490	637590	637690	637790	637890	637990	638090	638190	638289	638389	100
435	638489	638589	638689	638789	638888	638988	639088	639188	639287	639387	100
436	639486	639586	639686	639785	639885	639984	640084	640183	640283	640382	99
437	640481	640581	640680	640779	640879	640978	641077	641176	641276	641375	99
438	641474	641573	641672	641771	641870	641970	642069	642168	642267	642366	99
439	642464	642563	642662	642761	642860	642959	643058	643156	643255	643354	99
440	643453	643551	643650	643749	643847	643946	644044	644143	644242	644340	98
441	644439	644537	644635	644734	644832	644931	645029	645127	645226	645324	98
442	645422	645520	645619	645717	645815	645913	646011	646109	646208	646306	98
443	646404	646502	646600	646698	646796	646894	646991	647089	647187	647285	98
444	647383	647481	647579	647676	647774	647872	647969	648067	648165	648262	98
445	648360	648458	648555	648653	648750	648848	648945	649043	649140	649237	97
446	649335	649432	649530	649627	649724	649821	649919	650016	650113	650210	97
447	650307	650405	650502	650599	650696	650793	650890	650987	651084	651181	97
448	651278	651375	651472	651569	651666	651762	651859	651956	652053	652150	97
449	652246	652343	652440	652536	652633	652730	652826	652923	653019	653116	97
450	653213	653309	653405	653502	653598	653695	653791	653888	653984	654080	96
451	654176	654273	654369	654465	654562	654658	654754	654850	654946	655042	96
452	655138	655234	655331	655427	655523	655619	655714	655810	655906	656002	96
453	656098	656194	656290	656386	656481	656577	656673	656769	656864	656960	96
454	657056	657151	657247	657343	657438	657534	657629	657725	657820	657916	96
455	658011	658107	658202	658298	658393	658488	658584	658679	658774	658870	95
456	658965	659060	659155	659250	659346	659441	659536	659631	659726	659821	95
457	659916	660011	660106	660201	660296	660391	660486	660581	660676	660771	95
458	660865	660960	661055	661150	661245	661339	661434	661529	661623	661718	95
459	661813	661907	662002	662096	662191	662285	662380	662474	662569	662663	95
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 4600——5200 Log. 662758——716003

No.	0	1	2	3	4	5	6	7	8	9	Diff.
460	662758	662852	662947	663041	663135	663230	663324	663418	663512	663607	94
461	663701	663795	663889	663983	664078	664172	664266	664360	664454	664548	94
462	664642	664736	664830	664924	665018	665112	665206	665299	665393	665487	94
463	665581	665675	665769	665862	665956	666050	666143	666237	666331	666424	94
464	666518	666612	666705	666799	666892	666986	667079	667173	667266	667359	94
465	667453	667546	667640	667733	667826	667920	668013	668106	668199	668293	93
466	668386	668479	668572	668665	668758	668852	668945	669038	669131	669224	93
467	669317	669410	669503	669596	669689	669782	669875	669967	670060	670153	93
468	670246	670339	670431	670524	670617	670710	670802	670895	670988	671080	93
469	671173	671265	671358	671451	671543	671636	671728	671821	671913	672005	93
470	672098	672190	672283	672375	672467	672560	672652	672744	672836	672929	92
471	673021	673113	673205	673297	673390	673482	673574	673666	673758	673850	92
472	673942	674034	674126	674218	674310	674402	674494	674586	674677	674769	92
473	674861	674953	675045	675136	675228	675320	675412	675503	675595	675687	92
474	675778	675870	675962	676053	676145	676236	676328	676419	676511	676602	92
475	676694	676785	676876	676968	677059	677151	677242	677333	677424	677516	91
476	677607	677698	677789	677881	677972	678063	678154	678245	678336	678427	91
477	678518	678609	678700	678791	678882	678973	679064	679155	679246	679337	91
478	679428	679519	679610	679700	679791	679882	679973	680063	680154	680245	91
479	680335	680426	680517	680607	680698	680789	680879	680970	681060	681151	91
480	681241	681332	681422	681513	681603	681693	681784	681874	681964	682055	90
481	682145	682235	682326	682416	682506	682596	682686	682777	682867	682957	90
482	683047	683137	683227	683317	683407	683497	683587	683677	683767	683857	90
483	683947	684037	684127	684217	684307	684396	684486	684576	684666	684756	90
484	684845	684935	685025	685114	685204	685294	685383	685473	685563	685652	90
485	685742	685831	685921	686010	686100	686189	686279	686368	686457	686547	89
486	686636	686726	686815	686904	686994	687083	687172	687261	687351	687440	89
487	687529	687618	687707	687796	687886	687975	688064	688153	688242	688331	89
488	688420	688509	688598	688687	688776	688865	688953	689042	689131	689220	89
489	689309	689398	689486	689575	689664	689753	689841	689930	690019	690107	89
490	690196	690285	690373	690462	690550	690639	690727	690816	690905	690993	89
491	691081	691170	691258	691347	691435	691524	691612	691700	691789	691877	88
492	691965	692053	692142	692230	692318	692406	692494	692583	692671	692759	88
493	692847	692935	693023	693111	693199	693287	693375	693463	693551	693639	88
494	693727	693815	693903	693991	694078	694166	694254	694342	694430	694517	88
495	694605	694693	694781	694868	694956	695044	695131	695219	695307	695394	88
496	695482	695569	695657	695744	695832	695919	696007	696094	696182	696269	87
497	696356	696444	696531	696618	696706	696793	696880	696968	697055	697142	87
498	697229	697317	697404	697491	697578	697665	697752	697839	697926	698013	87
499	698100	698188	698275	698362	698448	698535	698622	698709	698796	698883	87
500	698970	699057	699144	699231	699317	699404	699491	699578	699664	699751	87
501	699838	699924	700011	700098	700184	700271	700358	700444	700531	700617	87
502	700704	700790	700877	700963	701050	701136	701222	701309	701395	701482	86
503	701568	701654	701741	701827	701913	701999	702086	702172	702258	702344	86
504	702430	702517	702603	702689	702775	702861	702947	703033	703119	703205	86
505	703291	703377	703463	703549	703635	703721	703807	703893	703979	704065	86
506	704150	704236	704322	704408	704494	704579	704665	704751	704837	704922	86
507	705008	705094	705179	705265	705350	705436	705522	705607	705693	705778	86
508	705864	705949	706035	706120	706206	706291	706376	706462	706547	706632	85
509	706718	706803	706888	706974	707059	707144	707229	707315	707400	707485	85
510	707570	707655	707740	707826	707911	707996	708081	708166	708251	708336	85
511	708421	708506	708591	708676	708761	708846	708931	709015	709100	709185	85
512	709270	709355	709440	709524	709609	709694	709779	709863	709948	710033	85
513	710117	710202	710287	710371	710456	710540	710625	710710	710794	710879	85
514	710963	711048	711132	711216	711301	711385	711470	711554	711638	711723	84
515	711807	711892	711976	712060	712144	712229	712313	712397	712481	712566	84
516	712650	712734	712818	712902	712986	713070	713154	713238	713322	713406	84
517	713490	713574	713658	713742	713826	713910	713994	714078	714162	714246	84
518	714330	714414	714497	714581	714665	714749	714832	714916	715000	715084	84
519	715167	715251	715335	715418	715502	715586	715669	715753	715836	715920	84
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 5200——5800 Log. 716003——763428

No.	0	1	2	3	4	5	6	7	8	9	Diff.
520	716003	716087	716170	716254	·16337	716421	716504	716588	716671	716754	83
521	716838	716921	717004	717088	·17171	717254	717338	717421	717504	717587	83
522	717671	717754	717837	717920	718003	718086	718169	718253	718336	718419	83
523	718502	718585	718668	718751	718834	718917	719000	719083	719165	719248	83
524	719331	719414	719497	719580	719663	719745	719828	719911	719994	720077	83
525	720159	720242	720325	720407	720490	720573	720655	720738	720821	720903	83
526	720986	721068	721151	721233	721316	721398	721481	721563	721646	721728	82
527	721811	721893	721975	722058	722140	722222	722305	722387	722469	722552	82
528	722634	722716	722798	722881	722963	723045	723127	723209	723291	723374	82
529	723456	723538	723620	723702	723784	723866	723948	724030	724112	724194	82
530	724276	724358	724440	724522	724603	724685	724767	724849	724931	725013	82
531	725095	725176	725258	725340	725422	725503	725585	725667	725748	725830	82
532	725912	725993	726075	726156	726238	726320	726401	726483	726564	726646	82
533	726727	726809	726890	726972	727053	727134	727216	727297	727379	727460	81
534	727541	727623	727704	727785	727866	727948	728029	728110	728191	728273	81
535	728354	728435	728516	728597	728678	728759	728841	728922	729003	729084	81
536	729165	729246	729327	729408	729489	729570	729651	729732	729813	729893	81
537	729974	730055	730136	730217	730298	730378	730459	730540	730621	730702	81
538	730782	730863	730944	731024	731105	731186	731266	731347	731428	731508	81
539	731589	731669	731750	731830	731911	731991	732072	732152	732233	732313	81
540	732394	732474	732555	732635	732715	732796	732876	732956	733037	733117	80
541	733197	733278	733358	733438	733518	733598	733679	733759	733839	733919	80
542	733999	734079	734159	734240	734320	734400	734480	734560	734640	734720	80
543	734800	734880	734960	735040	735120	735200	735279	735359	735439	735519	80
544	735599	735679	735759	735838	735918	735998	736078	736157	736237	736317	80
545	736396	736476	736556	736635	736715	736795	736874	736954	737034	737113	80
546	737193	737272	737352	737431	737511	737590	737670	737749	737829	737908	79
547	737987	738067	738146	738225	738305	738384	738463	738543	738622	738701	79
548	738781	738860	738939	739018	739097	739177	739256	739335	739414	739493	79
549	739572	739651	739730	739810	739889	739968	740047	740126	740205	740284	79
550	740363	740442	740521	740599	740678	740757	740836	740915	740994	741073	79
551	741152	741230	741309	741388	741467	741546	741624	741703	741782	741860	79
552	741939	742018	742096	742175	742254	742332	742411	742489	742568	742647	79
553	742725	742804	742882	742961	743039	743118	743196	743275	743353	743431	78
554	743510	743588	743667	743745	743823	743902	743980	744058	744136	744215	78
555	744293	744371	744449	744528	744606	744684	744762	744840	744919	744997	78
556	745075	745153	745231	745309	745387	745465	745543	745621	745699	745777	78
557	745855	745933	746011	746089	746167	746245	746323	746401	746479	746556	78
558	746634	746712	746790	746868	746945	747023	747101	747179	747256	747334	78
559	747412	747489	747567	747645	747722	747800	747878	747955	748033	748110	78
560	748188	748266	748343	748421	748498	748576	748653	748731	748808	748885	77
561	748963	749040	749118	749195	749272	749350	749427	749504	749582	749659	77
562	749736	749814	749891	749968	750045	750123	750200	750277	750354	750431	77
563	750508	750586	750663	750740	750817	750894	750971	751048	751125	751202	77
564	751279	751356	751433	751510	751587	751664	751741	751818	751895	751972	77
565	752048	752125	752202	752279	752356	752433	752509	752586	752663	752740	77
566	752816	752893	752970	753047	753123	753200	753277	753353	753430	753506	77
567	753583	753660	753736	753813	753889	753966	754042	754119	754195	754272	77
568	754348	754425	754501	754578	754654	754730	754807	754883	754960	755036	76
569	755112	755189	755265	755341	755417	755494	755570	755646	755722	755799	76
570	755875	755951	756027	756103	756180	756256	756332	756408	756484	756560	76
571	756636	756712	756788	756864	756940	757016	757092	757168	757244	757320	76
572	757396	757472	757548	757624	757700	757775	757851	757927	758003	758079	76
573	758155	758230	758306	758382	758458	758533	758609	758685	758761	758836	76
574	758912	758988	759063	759139	759214	759290	759366	759441	759517	759592	76
575	759668	759743	759819	759894	759970	760045	760121	760196	760272	760347	75
576	760422	760498	760573	760649	760724	760799	760875	760950	761025	761101	75
577	761176	761251	761326	761402	761477	761552	761627	761702	761778	761853	75
578	761928	762003	762078	762153	762228	762303	762378	762453	762529	762604	75
579	762679	762754	762829	762904	762978	763053	763128	763203	763278	763353	75
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 5800——6400 Log. 763428——806180

No.	0	1	2	3	4	5	6	7	8	9	Diff.
580	763428	763503	763578	763653	763727	763802	763877	763952	764027	764101	75
581	764176	76425	764326	764400	764475	764550	764624	764699	764774	764848	75
582	764923	764998	765072	765147	765221	765296	765370	765445	765520	765594	75
583	765669	765743	765818	765892	765966	766041	766115	766190	-66264	766338	74
584	766413	766487	766562	766636	766710	766785	766859	766933	767007	767082	74
585	767156	767230	767304	767379	767453	767527	767601	767675	767749	767823	74
585	767898	767972	768046	768120	768194	768268	768342	768416	768490	768564	74
587	768638	768712	768786	768860	768934	769008	769082	769156	769230	769303	74
588	769377	769451	769525	769599	769673	769746	769820	769894	769968	770042	74
589	770115	770189	770263	770336	770410	770484	770557	770631	770705	770778	74
590	770852	770926	770999	771073	771146	771220	771293	771367	771440	771514	74
591	771587	771661	771734	771808	771881	771955	772028	772102	772175	772248	73
592	772322	772395	772468	772542	772615	772688	772762	772835	772908	772981	73
593	773055	773128	773201	773274	773348	773421	773494	773567	773640	773713	73
594	773786	773860	773933	774006	774079	774152	774225	774298	774371	774444	73
595	774517	774590	774663	774736	774809	774882	774955	775028	775100	775173	73
596	775246	775319	775392	775465	775538	775610	775683	775756	775829	775902	73
597	775974	776047	776120	776193	776265	776338	776411	776483	776556	776629	73
598	776701	776774	776846	776919	776992	777064	777137	777209	777282	777354	73
599	777427	777499	777572	777644	777717	777789	777862	777934	778006	778079	73
600	778151	778224	778296	778368	778441	778513	778585	778658	778730	778802	72
601	778874	778947	779019	779091	779163	779236	779308	779380	779452	779524	72
602	779596	779669	779741	779813	779885	779957	780029	780101	780173	780245	72
603	780317	780389	780461	780533	780605	780677	780749	780821	780893	780965	72
604	781037	781109	781181	781253	781324	781396	781468	781540	781612	781684	72
605	781755	781827	781899	781971	782042	782114	782186	782258	782329	782401	72
606	782473	782544	782616	782688	782759	782831	782902	782974	783046	783117	72
607	783189	783260	783332	783403	783475	783546	783618	783689	783761	783832	71
608	783904	783975	784046	784118	784189	784261	784332	784403	784475	784546	71
609	784617	784689	784760	784831	784902	784974	785045	785116	785187	785259	71
610	785330	785401	785472	785543	785615	785686	785757	785828	785899	785970	71
611	786041	786112	786183	786254	786325	786396	786467	786538	786609	786680	71
612	786751	786822	786893	786964	787035	787106	787177	787248	787319	787390	71
613	787460	787531	787602	787673	787744	787815	787885	787956	788027	788098	71
614	788168	788239	788310	788381	788451	788522	788593	788663	788734	788804	71
615	788875	788946	789016	789087	789157	789228	789299	789369	789440	789510	71
616	789581	789651	789722	789792	789863	789933	790004	790074	790144	790215	70
617	790285	790356	790426	790496	790567	790637	790707	790778	790848	790918	70
618	790988	791059	791129	791199	791269	791340	791410	791480	791550	791620	70
619	791691	791761	791831	791901	791971	792041	792111	792181	792252	792322	70
620	792392	792462	792532	792602	792672	792742	792812	792882	792952	793022	70
621	793092	793162	793231	793301	793371	793441	793511	793581	793651	793721	70
622	793790	793860	793930	794000	794070	794139	794209	794279	794349	794418	70
623	794488	794558	794627	794697	794767	794836	794906	794976	795045	795115	70
624	795185	795254	795324	795393	795463	795532	795602	795671	795741	795811	69
625	795880	795949	796019	796088	796158	796227	796297	796366	796436	796505	69
626	796574	796644	796713	796782	796852	796921	796990	797060	797129	797198	69
627	797268	797337	797406	797475	797545	797614	797683	797752	797821	797890	69
628	797960	798029	798098	798167	798236	798305	798374	798443	798512	798582	69
629	798651	798720	798789	798858	798927	798996	799065	799134	799203	799272	69
630	799341	799409	799478	799547	799616	799685	799754	799823	799892	799961	69
631	800029	800098	800167	800236	800305	800373	800442	800511	800580	800648	69
632	800717	800786	800854	800923	800992	801060	801129	801198	801266	801335	69
633	801404	801472	801541	801609	801678	801747	801815	801884	801952	802021	69
634	802089	802158	802226	802295	802363	802432	802500	802568	802637	802705	68
635	802774	802842	802910	802979	803047	803116	803184	803252	803321	803389	68
636	803457	803525	803594	803662	803730	803798	803867	803935	804003	804071	68
637	804139	804208	804276	804344	804412	804480	804548	804616	804685	804753	68
638	804821	804889	804957	805025	805093	805161	805229	805297	805365	805433	68
639	805501	805569	805637	805705	805773	805841	805908	805976	806044	806112	68
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 6400——7000 Log. 806180——845098

No.	0	1	2	3	4	5	6	7	8	9	Diff.
640	806180	806248	806316	806384	806451	806519	806587	806655	806723	806790	68
641	806858	806926	806994	807061	807129	807197	807264	807332	807400	807467	68
642	807535	807603	807670	807738	807806	807873	807941	808008	808076	808143	68
643	808211	808279	808346	808414	808481	808549	808616	808684	808751	808818	68
644	808886	808953	809021	809088	809156	809223	809290	809358	809425	809492	67
645	809560	809627	809694	809762	809829	809896	809964	810031	810098	810165	67
646	810233	810300	810367	810434	810501	810569	810636	810703	810770	810837	67
647	810904	810971	811038	811106	811173	811240	811307	811374	811441	811508	67
648	811575	811642	811709	811776	811843	811910	811977	812044	812111	812178	67
649	812245	812312	812378	812445	812512	812579	812646	812713	812780	812847	67
650	812913	812980	813047	813114	813181	813247	813314	813381	813448	813514	67
651	813581	813648	813714	813781	813848	813914	813981	814048	814114	814181	67
652	814248	814314	814381	814447	814514	814581	814647	814714	814780	814847	67
653	814913	814980	815046	815113	815179	815246	815312	815378	815445	815511	66
654	815578	815644	815711	815777	815843	815910	815976	816042	816109	816175	66
655	816241	816308	816374	816440	816506	816573	816639	816705	816771	816838	66
656	816904	816970	817036	817102	817169	817235	817301	817367	817433	817499	66
657	817565	817631	817698	817764	817830	817896	817962	818028	818094	818160	66
658	818226	818292	818358	818424	818490	818556	818622	818688	818754	818819	66
659	818885	818951	819017	819083	819149	819215	819281	819346	819412	819478	66
660	819544	819610	819675	819741	819807	819873	819939	820004	820070	820136	66
661	820201	820267	820333	820399	820464	820530	820595	820661	820727	820792	66
662	820858	820924	820989	821055	821120	821186	821251	821317	821382	821448	66
663	821514	821579	821644	821710	821775	821841	821906	821972	822037	822103	65
664	822168	822233	822299	822364	822430	822495	822560	822626	822691	822756	65
665	822822	822887	822952	823018	823083	823148	823213	823279	823344	823409	65
666	823474	823539	823605	823670	823735	823800	823865	823930	823996	824061	65
667	824126	824191	824256	824321	824386	824451	824516	824581	824646	824711	65
668	824776	824841	824906	824971	825036	825101	825166	825231	825296	825361	65
669	825426	825491	825556	825621	825686	825751	825815	825880	825945	826010	65
670	826075	826140	826204	826269	826334	826399	826464	826528	826593	826658	65
671	826723	826787	826852	826917	826981	827046	827111	827175	827240	827305	65
672	827369	827434	827498	827563	827628	827692	827757	827821	827886	827951	65
673	828015	828080	828144	828209	828273	828338	828402	828407	828531	828595	64
674	828660	828724	828789	828853	828918	828982	829046	829111	829175	829239	64
675	829304	829368	829432	829497	829561	829625	829690	829754	829818	829882	64
676	829947	830011	830075	830139	830204	830268	830332	830396	830460	830525	64
677	830589	830653	830717	830781	830845	830909	830973	831037	831102	831166	64
678	831230	831294	831358	831422	831486	831550	831614	831678	831742	831806	64
679	831870	831934	831998	832062	832126	832189	832253	832317	832381	832445	64
680	832509	832573	832637	832700	832764	832828	832892	832956	833020	833083	64
681	833147	833211	833275	833338	833402	833466	833530	833593	833657	833721	64
682	833784	833848	833912	833975	834039	834103	834166	834230	834293	834357	64
683	834421	834484	834548	834611	834675	834739	834802	834866	834929	834993	64
684	835056	835120	835183	835247	835310	835373	835437	835500	835564	835627	63
685	835691	835754	835817	835881	835944	836007	836071	836134	836197	836261	63
686	836324	836387	836451	836514	836577	836641	836704	836767	836830	836894	63
687	836957	837020	837083	837146	837210	837273	837336	837399	837462	837525	63
688	837588	837652	837715	837778	837841	837904	837967	838030	838093	838156	63
689	838219	838282	838345	838408	838471	838534	838597	838660	838723	838786	63
690	838849	838912	838975	839038	839101	839164	839227	839289	839352	839415	63
691	839478	839541	839604	839667	839729	839792	839855	839918	839981	840043	63
692	840106	840169	840232	840294	840357	840420	840482	840545	840608	840671	63
693	840733	840796	840859	840921	840984	841046	841109	841172	841234	841297	63
694	841359	841422	841485	841547	841610	841672	841735	841797	841860	841922	63
695	841985	842047	842110	842172	842235	842297	842360	842422	842484	842547	62
696	842609	842672	842734	842796	842859	842921	842983	843046	843108	843170	62
697	843233	843295	843357	843420	843482	843544	843606	843669	843731	843793	62
698	843855	843918	843980	844042	844104	844166	844229	844291	844353	844415	62
699	844477	844539	844601	844664	844726	844788	844850	844912	844974	845036	62
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 7000——7600 Log. 845098——880814

No.	0	1	2	3	4	5	6	7	8	9	Diff.
700	845098	845160	845222	845284	845346	845408	845470	845532	845594	845656	62
701	845718	845780	845842	845904	845966	846028	846090	846151	846213	846275	62
702	846337	846399	846461	846523	846584	846646	846708	846770	846832	846894	62
703	846955	847017	847079	847141	847202	847264	847326	847388	847449	847511	62
704	847573	847634	847696	847758	847819	847881	847943	848004	848066	848127	62
705	848189	848251	848312	848374	848435	848497	848559	848620	848682	848743	62
706	848805	848866	848928	848989	849051	849112	849174	849235	849296	849358	61
707	849419	849481	849542	849604	849665	849726	849788	849849	849911	849972	61
708	850033	850095	850156	850217	850279	850340	850401	850462	850524	850585	61
709	850646	850707	850769	850830	850891	850952	851014	851075	851136	851197	61
710	851258	851320	851381	851442	851503	851564	851625	851686	851747	851808	61
711	851870	851931	851992	852053	852114	852175	852236	852297	852358	852419	61
712	852480	852541	852602	852663	852724	852785	852846	852907	852968	853029	61
713	853090	853150	853211	853272	853333	853394	853455	853516	853576	853637	61
714	853698	853759	853820	853881	853941	854002	854063	854124	854185	854245	61
715	854306	854367	854427	854488	854549	854610	854670	854731	854792	854852	61
716	854913	854974	855034	855095	855156	855216	855277	855337	855398	855459	61
717	855519	855580	855640	855701	855761	855822	855882	855943	856003	856064	61
718	856124	856185	856245	856306	856366	856427	856487	856548	856608	856668	60
719	856729	856789	856850	856910	856970	857031	857091	857151	857212	857272	60
720	857332	857393	857453	857513	857574	857634	857694	857754	857815	857875	60
721	857935	857995	858056	858116	858176	858236	858297	858357	858417	858477	60
722	858537	858597	858657	858718	858778	858838	858898	858958	859018	859078	60
723	859138	859198	859258	859318	859378	859438	859499	859559	859619	859679	60
724	859739	859799	859858	859918	859978	860038	860098	860158	860218	860278	60
725	860338	860398	860458	860518	860578	860637	860697	860757	860817	860877	60
726	860937	860996	861056	861116	861176	861236	861295	861355	861415	861475	60
727	861534	861594	861654	861714	861773	861833	861893	861952	862012	862072	60
728	862131	862191	862251	862310	862370	862430	862489	862549	862608	862668	60
729	862728	862787	862847	862906	862966	863025	863085	863144	863204	863263	60
730	863323	863382	863442	863501	863561	863620	863680	863739	863798	863858	59
731	863917	863977	864036	864096	864155	864214	864274	864333	864392	864452	59
732	864511	864570	864630	864689	864748	864808	864867	864926	864985	865045	59
733	865104	865163	865222	865282	865341	865400	865459	865518	865578	865637	59
734	865696	865755	865814	865874	865933	865992	866051	866110	866169	866228	59
735	866287	866346	866405	866465	866524	866583	866642	866701	866760	866819	59
736	866878	866937	866996	867055	867114	867173	867232	867291	867350	867409	59
737	867467	867526	867585	867644	867703	867762	867821	867880	867939	867998	59
738	868056	868115	868174	868233	868292	868350	868409	868468	868527	868586	59
739	868644	868703	868762	868821	868879	868938	868997	869056	869114	869173	59
740	869232	869290	869349	869408	869466	869525	869584	869642	869701	869760	59
741	869818	869877	869935	869994	870053	870111	870170	870228	870287	870345	59
742	870404	870462	870521	870579	870638	870696	870755	870813	870872	870930	58
743	870989	871047	871106	871164	871223	871281	871339	871398	871456	871515	58
744	871573	871631	871690	871748	871806	871865	871923	871981	872040	872098	58
745	872156	872215	872273	872331	872389	872448	872506	872564	872622	872681	58
746	872739	872797	872855	872913	872972	873030	873088	873146	873204	873262	58
747	873321	873379	873437	873495	873553	873611	873669	873727	873785	873844	58
748	873902	873960	874018	874076	874134	874192	874250	874308	874366	874424	58
749	874482	874540	874598	874656	874714	874772	874830	874887	874945	875003	58
750	875061	875119	875177	875235	875293	875351	875409	875466	875524	875582	58
751	875640	875698	875756	875813	875871	875929	875987	876045	876102	876160	58
752	876218	876276	876333	876391	876449	876507	876564	876622	876680	876737	58
753	876795	876853	876910	876968	877026	877083	877141	877198	877256	877314	58
754	877371	877429	877486	877544	877602	877659	877717	877774	877832	877889	58
755	877947	878004	878062	878119	878177	878234	878292	878349	878407	878464	57
756	878522	878579	878637	878694	878751	878809	878866	878924	878981	879038	57
757	879096	879153	879211	879268	879325	879383	879440	879497	879555	879612	57
758	879669	879726	879784	879841	879898	879956	880013	880070	880127	880185	57
759	880242	880299	880356	880413	880471	880528	880585	880642	880699	880756	57
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 7600——8200 Log. 880814——913814

No.	0	1	2	3	4	5	6	7	8	9	Diff.
760	880814	880871	880928	880985	881042	881099	881156	881213	881270	881328	57
761	881385	881442	881499	881556	881613	881670	881727	881784	881841	881898	57
762	881955	882012	882069	882126	882183	882240	882297	882354	882411	882468	57
763	882524	882581	882638	882695	882752	882809	882866	882923	882980	883037	57
764	883093	883150	883207	883264	883321	883377	883434	883491	883548	883605	57
765	883661	883718	883775	883832	883888	883945	884002	884059	884115	884172	57
766	884229	884285	884342	884399	884455	884512	884569	884625	884682	884739	57
767	884795	884852	884909	884965	885022	885078	885135	885192	885248	885305	57
768	885361	885418	885474	885531	885587	885644	885700	885757	885813	885870	57
769	885926	885983	886039	886096	886152	886209	886265	886321	886378	886434	56
770	886491	886547	886604	886660	886716	886773	886829	886885	886942	886998	56
771	887054	887111	887167	887223	887280	887336	887392	887449	887505	887561	56
772	887617	887674	887730	887786	887842	887898	887955	888011	888067	888123	56
773	888179	888236	888292	888348	888404	888460	888516	888573	888629	888685	56
774	888741	888797	888853	888909	888965	889021	889077	889134	889190	889246	56
775	889302	889358	889414	889470	889526	889582	889638	889694	889750	889806	56
776	889862	889918	889974	890030	890086	890141	890197	890253	890309	890365	56
777	890421	890477	890533	890589	890644	890700	890756	890812	890868	890924	56
778	890980	891035	891091	891147	891203	891259	891314	891370	891426	891482	56
779	891537	891593	891649	891705	891760	891816	891872	891928	891983	892039	56
780	892095	892150	892206	892262	892317	892373	892429	892484	892540	892595	56
781	892651	892707	892762	892818	892873	892929	892985	893040	893096	893151	56
782	893207	893262	893318	893373	893429	893484	893540	893595	893651	893706	56
783	893762	893817	893873	893928	893984	894039	894094	894150	894205	894261	55
784	894316	894371	894427	894482	894538	894593	894648	894704	894759	894814	55
785	894870	894925	894980	895036	895091	895146	895201	895257	895312	895367	55
786	895423	895478	895533	895588	895643	895699	895754	895809	895864	895920	55
787	895975	896030	896085	896140	896195	896251	896306	896361	896416	896471	55
788	896526	896581	896636	896692	896747	896802	896857	896912	896967	897022	55
789	897077	897132	897187	897242	897297	897352	897407	897462	897517	897572	55
790	897627	897682	897737	897792	897847	897902	897957	898012	898067	898122	55
791	898176	898231	898286	898341	898396	898451	898506	898561	898615	898670	55
792	898725	898780	898835	898890	898944	898999	899054	899109	899164	899218	55
793	899273	899328	899383	899437	899492	899547	899602	899656	899711	899766	55
794	899820	899875	899930	899985	900039	900094	900149	900203	900258	900312	55
795	900367	900422	900476	900531	900586	900640	900695	900749	900804	900858	55
796	900913	900968	901022	901077	901131	901186	901240	901295	901349	901404	55
797	901458	901513	901567	901622	901676	901731	901785	901840	901894	901948	54
798	902003	902057	902112	902166	902221	902275	902329	902384	902438	902491	54
799	902547	902601	902655	902710	902764	902818	902873	902927	902981	903036	54
800	903090	903144	903198	903253	903307	903361	903416	903470	903524	903578	54
801	903632	903687	903741	903795	903849	903903	903958	904012	904066	904120	54
802	904174	904228	904283	904337	904391	904445	904499	904553	904607	904661	54
803	904715	904770	904824	904878	904932	904986	905040	905094	905148	905202	54
804	905256	905310	905364	905418	905472	905526	905580	905634	905688	905742	54
805	905796	905850	905904	905958	906012	906065	906119	906173	906227	906281	54
806	906335	906389	906443	906497	906550	906604	906658	906712	906766	906820	54
807	906873	906927	906981	907035	907089	907142	907196	907250	907304	907358	54
808	907411	907465	907519	907573	907626	907680	907734	907787	907841	907895	54
809	907948	908002	908056	908109	908163	908217	908270	908324	908378	908431	54
810	908485	908539	908592	908646	908699	908753	908807	908860	908914	908967	54
811	909021	909074	909128	909181	909235	909288	909342	909395	909449	909502	54
812	909556	909609	909663	909716	909770	909823	909877	909930	909984	910037	53
813	910090	910144	910197	910251	910304	910358	910411	910464	910518	910571	53
814	910624	910678	910731	910784	910838	910891	910944	910998	911051	911104	53
815	911158	911211	911264	911317	911371	911424	911477	911530	911584	911637	53
816	911690	911743	911797	911850	911903	911956	912009	912063	912116	912169	53
817	912222	912275	912328	912381	912435	912488	912541	912594	912647	912700	53
818	912753	912806	912859	912913	912966	913019	913072	913125	913178	913231	53
819	913284	913337	913390	913443	913496	913549	913602	913655	913708	913761	53
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 8200——8800 Log. 913814——944483

No.	0	1	2	3	4	5	6	7	8	9	Diff.
820	913814	913867	913920	913973	914026	914079	914131	914184	914237	914290	53
821	914343	914396	914449	914502	914555	914608	914660	914713	914766	914819	53
822	914872	914925	914977	915030	915083	915136	915189	915241	915294	915347	53
823	915400	915453	915505	915558	915611	915664	915716	915769	915822	915874	53
824	915927	915980	916033	916085	916138	916191	916243	916296	916349	916401	53
825	916454	916507	916559	916612	916664	916717	916770	916822	916875	916927	53
826	916980	917033	917085	917138	917190	917243	917295	917348	917400	917453	53
827	917505	917558	917610	917663	917715	917768	917820	917873	917925	917978	52
828	918030	918083	918135	918188	918240	918292	918345	918397	918450	918502	52
829	918555	918607	918659	918712	918764	918816	918869	918921	918973	919026	52
830	919078	919130	919183	919235	919287	919340	919392	919444	919496	919549	52
831	919601	919653	919705	919758	919810	919862	919914	919967	920019	920071	52
832	920123	920175	920228	920280	920332	920384	920436	920489	920541	920593	52
833	920645	920697	920749	920801	920853	920906	920958	921010	921062	921114	52
834	921166	921218	921270	921322	921374	921426	921478	921530	921582	921634	52
835	921686	921738	921790	921842	921894	921946	921998	922050	922102	922154	52
836	922206	922258	922310	922362	922414	922466	922518	922570	922622	922674	52
837	922725	922777	922829	922881	922933	922985	923037	923088	923140	923192	52
838	923244	923296	923348	923399	923451	923503	923555	923607	923658	923710	52
839	923762	923814	923865	923917	923969	924021	924072	924124	924176	924228	52
840	924279	924331	924383	924434	924486	924538	924589	924641	924693	924744	52
841	924796	924848	924899	924951	925002	925054	925106	925157	925209	925260	52
842	925312	925364	925415	925467	925518	925570	925621	925673	925724	925776	52
843	925828	925879	925931	925982	926034	926085	926137	926188	926239	926291	51
844	926342	926394	926445	926497	926548	926600	926651	926702	926754	926805	51
845	926857	926908	926959	927011	927062	927114	927165	927216	927268	927319	51
846	927370	927422	927473	927524	927576	927627	927678	927730	927781	927832	51
847	927883	927935	927986	928037	928088	928140	928191	928242	928293	928345	51
848	928396	928447	928498	928549	928601	928652	928703	928754	928805	928856	51
849	928908	928959	929010	929061	929112	929163	929214	929266	929317	929368	51
850	929419	929470	929521	929572	929623	929674	929725	929776	929827	929878	51
851	929930	929981	930032	930083	930134	930185	930236	930287	930338	930389	51
852	930440	930491	930541	930592	930643	930694	930745	930796	930847	930898	51
853	930949	931000	931051	931102	931153	931203	931254	931305	931356	931407	51
854	931458	931509	931560	931610	931661	931712	931763	931814	931864	931915	51
855	931966	932017	932068	932118	932169	932220	932271	932321	932372	932423	51
856	932474	932524	932575	932626	932677	932727	932778	932829	932879	932930	51
857	932981	933031	933082	933133	933183	933234	933285	933335	933386	933437	51
858	933487	933538	933588	933639	933690	933740	933791	933841	933892	933943	51
859	933993	934044	934094	934145	934195	934246	934296	934347	934397	934448	51
860	934498	934549	934599	934650	934700	934751	934801	934852	934902	934953	50
861	935003	935054	935104	935154	935205	935255	935306	935356	935406	935457	50
862	935507	935558	935608	935658	935709	935759	935809	935860	935910	935960	50
863	936011	936061	936111	936162	936212	936262	936313	936363	936413	936463	50
864	936514	936564	936614	936664	936715	936765	936815	936865	936916	936966	50
865	937016	937066	937116	937167	937217	937267	937317	937367	937418	937468	50
866	937518	937568	937618	937668	937718	937769	937819	937869	937919	937969	50
867	938019	938069	938119	938169	938219	938269	938319	938370	938420	938470	50
868	938520	938570	938620	938670	938720	938770	938820	938870	938920	938970	50
869	939020	939070	939120	939170	939220	939270	939319	939369	939419	939469	50
870	939519	939569	939619	939669	939719	939769	939819	939868	939918	939968	50
871	940018	940068	940118	940168	940218	940267	940317	940367	940417	940467	50
872	940516	940566	940616	940666	940716	940765	940815	940865	940915	940964	50
873	941014	941064	941114	941163	941213	941263	941313	941362	941412	941462	50
874	941511	941561	941611	941660	941710	941760	941809	941859	941909	941958	50
875	942008	942058	942107	942157	942206	942256	942306	942355	942405	942454	50
876	942504	942554	942603	942653	942702	942752	942801	942851	942900	942950	50
877	943000	943049	943099	943148	943198	943247	943297	943346	943396	943445	49
878	943494	943544	943593	943643	943692	943742	943791	943841	943890	943939	49
879	943989	944038	944088	944137	944186	944236	944285	944335	944384	944433	49
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 8800——9400 Log. 944483——973128

No.	0	1	2	3	4	5	6	7	8	9	Diff.
880	944483	944532	944581	944631	944680	944729	944779	944828	944877	944927	49
881	944976	945025	945074	945124	945173	945222	945272	945321	945370	945419	49
882	945469	945518	945567	945616	945665	945715	945764	945813	945862	945911	49
883	945961	946010	946059	946108	946157	946207	946256	946305	946354	946403	49
884	946452	946501	946550	946600	946649	946698	946747	946796	946845	946894	49
885	946943	946992	947041	947090	947139	947189	947238	947287	947336	947385	49
886	947434	947483	947532	947581	947630	947679	947728	947777	947826	947875	49
887	947924	947973	948021	948070	948119	948168	948217	948266	948315	948364	49
888	948413	948462	948511	948560	948608	948657	948706	948755	948804	948853	49
889	948902	948951	948999	949048	949097	949146	949195	949244	949292	949341	49
890	949390	949439	949488	949536	949585	949634	949683	949731	949780	949829	49
891	949878	949926	949975	950024	950073	950121	950170	950219	950267	950316	49
892	950365	950413	950462	950511	950560	950608	950657	950705	950754	950803	49
893	950851	950900	950949	950997	951046	951095	951143	951192	951240	951289	49
894	951337	951386	951435	951483	951532	951580	951629	951677	951726	951774	49
895	951823	951872	951920	951969	952017	952066	952114	952163	952211	952259	48
896	952308	952356	952405	952453	952502	952550	952599	952647	952696	952744	48
897	952792	952841	952889	952938	952986	953034	953083	953131	953180	953228	48
898	953276	953325	953373	953421	953470	953518	953566	953615	953663	953711	48
899	953760	953808	953856	953905	953953	954001	954049	954098	954146	954194	48
900	954242	954291	954339	954387	954435	954484	954532	954580	954628	954677	48
901	954725	954773	954821	954869	954918	954966	955014	955062	955110	955158	48
902	955206	955255	955303	955351	955399	955447	955495	955543	955592	955640	48
903	955688	955736	955784	955832	955880	955928	955976	956024	956072	956120	48
904	956168	956216	956264	956312	956361	956409	956457	956505	956553	956601	48
905	956649	956697	956745	956792	956840	956888	956936	956984	957032	957080	48
906	957128	957176	957224	957272	957320	957368	957416	957464	957511	957559	48
907	957607	957655	957703	957751	957799	957847	957894	957942	957990	958038	48
908	958086	958134	958181	958229	958277	958325	958373	958420	958468	958516	48
909	958564	958612	958659	958707	958755	958803	958850	958898	958946	958994	48
910	959041	959089	959137	959184	959232	959280	959328	959375	959423	959471	48
911	959518	959566	959614	959661	959709	959757	959804	959852	959900	959947	48
912	959995	960042	960090	960138	960185	960233	960281	960328	960376	960423	48
913	960471	960518	960566	960613	960661	960709	960756	960804	960851	960899	48
914	960946	960994	961041	961089	961136	961184	961231	961279	961326	961374	48
915	961421	961469	961516	961563	961611	961658	961706	961753	961801	961848	47
916	961895	961943	961990	962038	962085	962132	962180	962227	962275	962322	47
917	962369	962417	962464	962511	962559	962606	962653	962701	962748	962795	47
918	962843	962890	962937	962985	963032	963079	963126	963174	963221	963268	47
919	963315	963363	963410	963457	963504	963552	963599	963646	963693	963741	47
920	963788	963835	963882	963929	963977	964024	964071	964118	964165	964212	47
921	964260	964307	964354	964401	964448	964495	964542	964590	964637	964684	47
922	964731	964778	964825	964872	964919	964966	965013	965060	965108	965155	47
923	965202	965249	965296	965343	965390	965437	965484	965531	965578	965625	47
924	965672	965719	965766	965813	965860	965907	965954	966001	966048	966095	47
925	966142	966189	966236	966283	966329	966376	966423	966470	966517	966564	47
926	966611	966658	966705	966752	966798	966845	966892	966939	966986	967033	47
927	967080	967127	967173	967220	967267	967314	967361	967408	967454	967501	47
928	967548	967595	967642	967688	967735	967782	967829	967875	967922	967969	47
929	968016	968062	968109	968156	968203	968249	968296	968343	968389	968436	47
930	968483	968530	968576	968623	968670	968716	968763	968810	968856	968903	47
931	968950	968996	969043	969090	969136	969183	969229	969276	969323	969369	47
932	969416	969462	969509	969556	969602	969649	969695	969742	969788	969835	47
933	969882	969928	969975	970021	970068	970114	970161	970207	970254	970300	47
934	970347	970393	970440	970486	970533	970579	970626	970672	970719	970765	47
935	970812	970858	970904	970951	970997	971044	971090	971137	971183	971229	46
936	971276	971322	971369	971415	971461	971508	971554	971600	971647	971693	46
937	971740	971786	971832	971879	971925	971971	972018	972064	972110	972156	46
938	972203	972249	972295	972342	972388	972434	972480	972527	972573	972619	46
939	972666	972712	972758	972804	972851	972897	972943	972989	973035	973082	46
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 9400——10000 Log. 973128——000000

No.	0	1	2	3	4	5	6	7	8	9	Diff.
940	973128	973174	973220	973266	973313	973359	973405	973451	973497	973543	46
941	973590	973636	973682	973728	973774	973820	973866	973913	973959	974005	46
942	974051	974097	974143	974189	974235	974281	974327	974373	974420	974466	46
943	974512	974558	974604	974650	974696	974742	974788	974834	974880	974926	46
944	974972	975018	975064	975110	975156	975202	975248	975294	975340	975386	46
945	975432	975478	975524	975570	975616	975661	975707	975753	975799	975845	46
946	975891	975937	975983	976029	976075	976121	976166	976212	976258	976304	46
947	976350	976396	976442	976487	976533	976579	976625	976671	976717	976762	46
948	976808	976854	976900	976946	976991	977037	977083	977129	977175	977220	46
949	977266	977312	977358	977403	977449	977495	977541	977586	977632	977678	46
950	977724	977769	977815	977861	977906	977952	977998	978043	978089	978135	46
951	978180	978226	978272	978317	978363	978409	978454	978500	978546	978591	46
952	978637	978683	978728	978774	978819	978865	978911	978956	979002	979047	46
953	979093	979138	979184	979230	979275	979321	979366	979412	979457	979503	46
954	979548	979594	979639	979685	979730	979776	979821	979867	979912	979958	46
955	980003	980049	980094	980140	980185	980231	980276	980322	980367	980412	45
956	980458	980503	980549	980594	980640	980685	980730	980776	980821	980867	45
957	980912	980957	981003	981048	981093	981139	981184	981229	981275	981320	45
958	981365	981411	981456	981501	981547	981592	981637	981683	981728	981773	45
959	981819	981864	981909	981954	982000	982045	982090	982135	982181	982226	45
960	982271	982316	982362	982407	982452	982497	982543	982588	982633	982678	45
961	982723	982769	982814	982859	982904	982949	982994	983040	983085	983130	45
962	983175	983220	983265	983310	983356	983401	983446	983491	983536	983581	45
963	983626	983671	983716	983762	983807	983852	983897	983942	983987	984032	45
964	984077	984122	984167	984212	984257	984302	984347	984392	984437	984482	45
965	984527	984572	984617	984662	984707	984752	984797	984842	984887	984932	45
966	984977	985022	985067	985112	985157	985202	985247	985292	985337	985382	45
967	985426	985471	985516	985561	985606	985651	985696	985741	985786	985830	45
968	985875	985920	985965	986010	986055	986100	986144	986189	986234	986279	45
969	986324	986369	986413	986458	986503	986548	986593	986637	986682	986727	45
970	986772	986816	986861	986906	986951	986995	987040	987085	987130	987174	45
971	987219	987264	987309	987353	987398	987443	987487	987532	987577	987622	45
972	987666	987711	987756	987800	987845	987890	987934	987979	988024	988068	45
973	988113	988157	988202	988247	988291	988336	988381	988425	988470	988514	45
974	988559	988603	988648	988693	988737	988782	988826	988871	988915	988960	45
975	989005	989049	989094	989138	989183	989227	989272	989316	989361	989405	45
976	989450	989494	989539	989583	989628	989672	989717	989761	989806	989850	44
977	989895	989939	989983	990028	990072	990117	990161	990206	990250	990294	44
978	990339	990383	990428	990472	990516	990561	990605	990650	990694	990738	44
979	990783	990827	990871	990916	990960	991004	991049	991093	991137	991182	44
980	991226	991270	991315	991359	991403	991448	991492	991536	991580	991625	44
981	991669	991713	991757	991802	991846	991890	991934	991979	992023	992067	44
982	992111	992156	992200	992244	992288	992333	992377	992421	992465	992509	44
983	992553	992598	992642	992686	992730	992774	992818	992863	992907	992951	44
984	992995	993039	993083	993127	993172	993216	993260	993304	993348	993392	44
985	993436	993480	993524	993568	993613	993657	993701	993745	993789	993833	44
986	993877	993921	993965	994009	994053	994097	994141	994185	994229	994273	44
987	994317	994361	994405	994449	994493	994537	994581	994625	994669	994713	44
988	994757	994801	994845	994889	994933	994977	995021	995064	995108	995152	44
989	995196	995240	995284	995328	995372	995416	995460	995504	995547	995591	44
990	995635	995679	995723	995767	995811	995854	995898	995942	995986	996030	44
991	996074	996117	996161	996205	996249	996293	996336	996380	996424	996468	44
992	996512	996555	996599	996643	996687	996730	996774	996818	996862	996905	44
993	996949	996993	997037	997080	997124	997168	997212	997255	997299	997343	44
994	997386	997430	997474	997517	997561	997605	997648	997692	997736	997779	44
995	997823	997867	997910	997954	997998	998041	998085	998128	998172	998216	44
996	998259	998303	998346	998390	998434	998477	998521	998564	998608	998652	44
997	998695	998739	998782	998826	998869	998913	998956	999000	999043	999087	44
998	999130	999174	999218	999261	999305	999348	999392	999435	999478	999522	44
999	999565	999609	999652	999696	999739	999783	999826	999870	999913	999957	43
	0	1	2	3	4	5	6	7	8	9	

TABLE XXV.

LOGARITHMIC SINES.

Sine 0 Degree.

M	0″	10″	20″	30″	40″	50″		Diff.
0		5.685575	5.986605	6.162696	6.287635	6.384545	59	
1	6.463726	6.530673	6.588665	6.639817	6.685575	6.726967	58	
2	6.764756	6.799518	6.831703	6.861666	6.889695	6.916024	57	
3	6.940847	6.964328	6.986605	7.007794	7.027997	7.047303	56	
4	7.065786	7.083515	7.100548	7.116938	7.132733	7.147973	55	
5	7.162696	7.176936	7.190725	7.204089	7.217054	7.229643	54	
6	7.241877	7.253776	7.265358	7.276639	7.287635	7.298358	53	
7	7.308824	7.319043	7.329027	7.338787	7.348332	7.357672	52	
8	7.366816	7.375770	7.384544	7.393145	7.401578	7.409850	51	
9	7.417968	7.425937	7.433762	7.441449	7.449002	7.456426	50	
10	7.463725	7.470904	7.477966	7.484915	7.491754	7.498487	49	6894
11	7.505118	7.511649	7.518083	7.524423	7.530672	7.536832	48	6294
12	7.542906	7.548897	7.554806	7.560635	7.566387	7.572065	47	5791
13	7.577668	7.583201	7.588664	7.594059	7.599388	7.604652	46	5362
14	7.609853	7.614993	7.620072	7.625093	7.630056	7.634963	45	4992
15	7.639816	7.644615	7.649361	7.654056	7.658701	7.663297	44	4670
16	7.667844	7.672345	7.676799	7.681208	7.685573	7.689894	43	4387
17	7.694173	7.698410	7.702606	7.706762	7.710879	7.714957	42	4136
18	7.718997	7.722999	7.726965	7.730896	7.734791	7.738651	41	3913
19	7.742477	7.746270	7.750031	7.753758	7.757454	7.761119	40	3712
20	7.764754	7.768358	7.771932	7.775477	7.778994	7.782482	39	3531
21	7.785943	7.789376	7.792782	7.796162	7.799515	7.802843	38	3366
22	7.806146	7.809423	7.812677	7.815905	7.819111	7.822292	37	3217
23	7.825451	7.828586	7.831700	7.834791	7.837860	7.840907	36	3030
24	7.843934	7.846939	7.849924	7.852888	7.855833	7.858757	35	2954
25	7.861662	7.864548	7.867414	7.870262	7.873092	7.875902	34	2838
26	7.878695	7.881470	7.884228	7.886968	7.889690	7.892396	33	2731
27	7.895085	7.897758	7.900414	7.903054	7.905678	7.908287	32	2632
28	7.910879	7.913457	7.916019	7.918566	7.921098	7.923616	31	2540
29	7.926119	7.928608	7.931082	7.933543	7.935989	7.938422	30	2453
30	7.940842	7.943248	7.945641	7.948020	7.950387	7.952741	29	2373
31	7.955082	7.957410	7.959727	7.962031	7.964322	7.966602	28	2297
32	7.968870	7.971126	7.973370	7.975603	7.977824	7.980034	27	2227
33	7.982233	7.984421	7.986598	7.988764	7.990919	7.993064	26	2161
34	7.995198	7.997322	7.999435	8.001538	8.003631	8.005714	25	2098
35	8.007787	8.009850	8.011903	8.013947	8.015981	8.018005	24	2039
36	8.020021	8.022027	8.024023	8.026011	8.027989	8.029959	23	1983
37	8.031919	8.033871	8.035814	8.037749	8.039675	8.041592	22	1930
38	8.043501	8.045401	8.047294	8.049178	8.051054	8.052922	21	1880
39	8.054781	8.056633	8.058477	8.060314	8.062142	8.063963	20	1832
40	8.065776	8.067582	8.069380	8.071171	8.072955	8.074731	19	1787
41	8.076500	8.078261	8.080016	8.081764	8.083504	8.085238	18	1744
42	8.086965	8.088684	8.090398	8.092104	8.093804	8.095497	17	1703
43	8.097183	8.098863	8.100537	8.102204	8.103864	8.105519	16	1664
44	8.107167	8.108809	8.110444	8.112074	8.113697	8.115315	15	1626
45	8.116926	8.118532	8.120131	8.121725	8.123313	8.124895	14	1590
46	8.126471	8.128042	8.129606	8.131166	8.132720	8.134268	13	1556
47	8.135810	8.137348	8.138879	8.140406	8.141927	8.143443	12	1524
48	8.144953	8.146458	8.147959	8.149453	8.150943	8.152428	11	1492
49	8.153907	8.155382	8.156852	8.158316	8.159776	8.161231	10	1462
50	8.162681	8.164126	8.165566	8.167002	8.168433	8.169859	9	1432
51	8.171280	8.172697	8.174109	8.175517	8.176920	8.178319	8	1405
52	8.179713	8.181102	8.182488	8.183868	8.185245	8.186617	7	1379
53	8.187985	8.189348	8.190707	8.192062	8.193413	8.194760	6	1353
54	8.196102	8.197440	8.198774	8.200104	8.201430	8.202752	5	1328
55	8.204070	8.205384	8.206694	8.208000	8.209302	8.210601	4	1304
56	8.211895	8.213185	8.214472	8.215755	8.217034	8.218309	3	1281
57	8.219581	8.220849	8.222113	8.223374	8.224631	8.225884	2	1258
58	8.227133	8.228380	8.229622	8.230861	8.232096	8.233328	1	1237
59	8.234557	8.235782	8.237003	8.238221	8.239436	8.240647	0	1216
	60″	50″	40″	30″	20″	10″	M	

Co-sine 89 Degrees.

TABLE XXV.

LOGARITHMIC TANGENTS.

Tangent 0 Degree.

M	0″	10″	20″	30″	40″	50″		Diff.
0		5.685575	5.986605	6.162696	6.287635	6.384545	59	
1	6.463726	6.530673	6.588665	6.639817	6.685575	6.726968	58	
2	6.764756	6.799518	6.831703	6.861666	6.889695	6.916024	57	
3	6.940847	6.964329	6.986605	7.007794	7.027998	7.047303	56	
4	7.065786	7.083515	7.100548	7.116939	7.132733	7.147973	55	
5	7.162696	7.176937	7.190725	7.204089	7.217054	7.229643	54	
6	7.241878	7.253777	7.265359	7.276640	7.287635	7.298359	53	
7	7.308825	7.319044	7.329028	7.338788	7.348333	7.357673	52	
8	7.366817	7.375772	7.384546	7.393146	7.401579	7.409852	51	
9	7.417970	7.425939	7.433764	7.441451	7.449004	7.456428	50	
10	7.463727	7.470906	7.477968	7.484917	7.491756	7.498490	49	6894
11	7.505120	7.511651	7.518085	7.524426	7.530675	7.536835	48	6294
12	7.542909	7.548900	7.554808	7.560638	7.566390	7.572068	47	5791
13	7.577671	7.583204	7.588667	7.594062	7.599391	7.604655	46	5362
14	7.609857	7.614996	7.620076	7.625097	7.630060	7.634968	45	4992
15	7.639820	7.644619	7.649366	7.654061	7.658706	7.663301	44	4670
16	7.667849	7.672350	7.676804	7.681213	7.685578	7.689900	43	4387
17	7.694179	7.698416	7.702612	7.706768	7.710885	7.714962	42	4136
18	7.719003	7.723005	7.726972	7.730902	7.734797	7.738658	41	3913
19	7.742484	7.746277	7.750037	7.753765	7.757462	7.761127	40	3712
20	7.764761	7.768365	7.771940	7.775485	7.779002	7.782490	39	3531
21	7.785951	7.789384	7.792790	7.796170	7.799524	7.802852	38	3367
22	7.806155	7.809432	7.812686	7.815915	7.819120	7.822302	37	3217
23	7.825460	7.828596	7.831710	7.834801	7.837870	7.840918	36	3080
24	7.843944	7.846950	7.849935	7.852900	7.855844	7.858769	35	2954
25	7.861674	7.864560	7.867426	7.870274	7.873104	7.875915	34	2839
26	7.878708	7.881483	7.884240	7.886981	7.889704	7.892410	33	2732
27	7.895099	7.897771	7.900428	7.903068	7.905692	7.908301	32	2632
28	7.910894	7.913471	7.916034	7.918581	7.921113	7.923631	31	2540
29	7.926134	7.928623	7.931098	7.933559	7.936006	7.938439	30	2454
30	7.940858	7.943265	7.945657	7.948037	7.950404	7.952758	29	2373
31	7.955100	7.957428	7.959745	7.962049	7.964341	7.966621	28	2298
32	7.968889	7.971145	7.973389	7.975622	7.977844	7.980054	27	2227
33	7.982253	7.984441	7.986618	7.988785	7.990940	7.993085	26	2161
34	7.995219	7.997343	7.999456	8.001560	8.003653	8.005736	25	2098
35	8.007809	8.009872	8.011926	8.013970	8.016004	8.018029	24	2039
36	8.020044	8.022051	8.024047	8.026035	8.028014	8.029984	23	1983
37	8.031945	8.033897	8.035840	8.037775	8.039701	8.041618	22	1930
38	8.043527	8.045428	8.047321	8.049205	8.051081	8.052949	21	1880
39	8.054809	8.056661	8.058506	8.060342	8.062171	8.063992	20	1833
40	8.065806	8.067612	8.069410	8.071201	8.072985	8.074761	19	1787
41	8.076531	8.078293	8.080047	8.081795	8.083536	8.085270	18	1744
42	8.086997	8.088717	8.090430	8.092137	8.093837	8.095530	17	1703
43	8.097217	8.098897	8.100571	8.102239	8.103899	8.105554	16	1664
44	8.107202	8.108845	8.110481	8.112110	8.113734	8.115352	15	1627
45	8.116963	8.118569	8.120169	8.121763	8.123351	8.124933	14	1591
46	8.126510	8.128081	8.129646	8.131206	8.132760	8.134308	13	1557
47	8.135851	8.137389	8.138921	8.140447	8.141969	8.143485	12	1524
48	8.144996	8.146501	8.148001	8.149497	8.150987	8.152472	11	1493
49	8.153952	8.155426	8.156896	8.158361	8.159821	8.161276	10	1462
50	8.162727	8.164172	8.165613	8.167049	8.168480	8.169906	9	1434
51	8.171328	8.172745	8.174158	8.175566	8.176969	8.178368	8	1406
52	8.179763	8.181152	8.182538	8.183919	8.185296	8.186668	7	1379
53	8.188036	8.189400	8.190760	8.192115	8.193466	8.194813	6	1353
54	8.196156	8.197494	8.198829	8.200159	8.201485	8.202808	5	1328
55	8.204126	8.205440	8.206750	8.208057	8.209359	8.210658	4	1304
56	8.211953	8.213243	8.214530	8.215814	8.217093	8.218369	3	1281
57	8.219641	8.220909	8.222174	8.223434	8.224692	8.225945	2	1259
58	8.227195	8.228442	8.229685	8.230924	8.232160	8.233392	1	1238
59	8.234621	8.235846	8.237068	8.238286	8.239501	8.240713	0	1217
	60″	50″	40″	30″	20″	10″	M	

Co-tangent 89 Degrees.

TABLE XXV.

LOGARITHMIC SINES.

Sine 1 Degree.

M	0″	10″	20″	30″	40″	50″		Diff.
0	8.241855	8.243060	8.244261	8.245459	8.246654	8.247845	59	1196
1	8.249033	8.250218	8.251400	8.252578	8.253753	8.254925	58	1177
2	8.256094	8.257260	8.258423	8.259582	8.260739	8.261892	57	1158
3	8.263042	8.264190	8.265334	8.266475	8.267613	8.268749	56	1140
4	8.269881	8.271010	8.272137	8.273260	8.274381	8.275499	55	1122
5	8.276614	8.277726	8.278835	8.279941	8.281045	8.282145	54	1105
6	8.283243	8.284339	8.285431	8.286521	8.287608	8.288692	53	1088
7	8.289773	8.290852	8.291928	8.293002	8.294073	8.295141	52	1072
8	8.296207	8.297270	8.298330	8.299388	8.300443	8.301496	51	1057
9	8.302546	8.303594	8.304639	8.305681	8.306721	8.307759	50	1041
10	8.308794	8.309827	8.310857	8.311885	8.312910	8.313933	49	1026
11	8.314954	8.315972	8.316987	8.318001	8.319012	8.320020	48	1012
12	8.321027	8.322031	8.323033	8.324032	8.325029	8.326024	47	998
13	8.327016	8.328007	8.328995	8.329980	8.330964	8.331945	46	984
14	8.332924	8.333901	8.334876	8.335848	8.336819	8.337787	45	971
15	8.338753	8.339717	8.340678	8.341638	8.342596	8.343551	44	958
16	8.344504	8.345455	8.346405	8.347352	8.348297	8.349240	43	946
17	8.350180	8.351119	8.352056	8.352991	8.353924	8.354855	42	933
18	8.355783	8.356710	8.357635	8.358558	8.359479	8.360398	41	922
19	8.361315	8.362230	8.363143	8.364054	8.364964	8.365871	40	910
20	8.366777	8.367681	8.368582	8.369482	8.370380	8.371277	39	899
21	8.372171	8.373063	8.373954	8.374843	8.375730	8.376615	38	888
22	8.377499	8.378380	8.379260	8.380138	8.381015	8.381889	37	877
23	8.382762	8.383633	8.384502	8.385370	8.386236	8.387100	36	866
24	8.387962	8.388823	8.389682	8.390539	8.391395	8.392249	35	856
25	8.393101	8.393951	8.394800	8.395647	8.396493	8.397337	34	846
26	8.398179	8.399020	8.399859	8.400696	8.401532	8.402366	33	836
27	8.403199	8.404030	8.404859	8.405687	8.406513	8.407338	32	827
28	8.408161	8.408983	8.409803	8.410621	8.411438	8.412254	31	817
29	8.413068	8.413880	8.414691	8.415500	8.416308	8.417114	30	808
30	8.417919	8.418722	8.419524	8.420324	8.421123	8.421921	29	799
31	8.422717	8.423511	8.424304	8.425096	8.425886	8.426675	28	791
32	8.427462	8.428248	8.429032	8.429815	8.430597	8.431377	27	782
33	8.432156	8.432933	8.433709	8.434484	8.435257	8.436029	26	774
34	8.436800	8.437569	8.438337	8.439103	8.439868	8.440632	25	766
35	8.441394	8.442155	8.442915	8.443674	8.444431	8.445186	24	758
36	8.445941	8.446694	8.447446	8.448196	8.448946	8.449694	23	750
37	8.450440	8.451186	8.451930	8.452672	8.453414	8.454154	22	742
38	8.454893	8.455631	8.456368	8.457103	8.457837	8.458570	21	735
39	8.459301	8.460032	8.460761	8.461489	8.462215	8.462941	20	727
40	8.463665	8.464388	8.465110	8.465830	8.466550	8.467268	19	720
41	8.467985	8.468701	8.469416	8.470129	8.470841	8.471553	18	713
42	8.472263	8.472971	8.473679	8.474386	8.475091	8.475795	17	706
43	8.476498	8.477200	8.477901	8.478601	8.479299	8.479997	16	699
44	8.480693	8.481388	8.482082	8.482775	8.483467	8.484158	15	692
45	8.484848	8.485536	8.486224	8.486910	8.487596	8.488280	14	686
46	8.488963	8.489645	8.490326	8.491006	8.491685	8.492363	13	679
47	8.493040	8.493715	8.494390	8.495064	8.495736	8.496408	12	673
48	8.497078	8.497748	8.498416	8.499084	8.499750	8.500415	11	667
49	8.501080	8.501743	8.502405	8.503067	8.503727	8.504386	10	661
50	8.505045	8.505702	8.506358	8.507014	8.507668	8.508321	9	655
51	8.508974	8.509625	8.510275	8.510925	8.511573	8.512221	8	649
52	8.512867	8.513513	8.514157	8.514801	8.515444	8.516086	7	643
53	8.516726	8.517366	8.518005	8.518643	8.519280	8.519916	6	637
54	8.520551	8.521186	8.521819	8.522451	8.523083	8.523713	5	632
55	8.524343	8.524972	8.525599	8.526226	8.526852	8.527477	4	626
56	8.528102	8.528725	8.529347	8.529969	8.530589	8.531209	3	621
57	8.531828	8.532446	8.533063	8.533679	8.534295	8.534909	2	616
58	8.535523	8.536136	8.536747	8.537358	8.537969	8.538578	1	610
59	8.539186	8.539794	8.540401	8.541007	8.541612	8.542216	0	605
	60″	50″	40″	30″	20″	10″	M	

Co-sine 88 Degrees.

TABLE XXV.

LOGARITHMIC TANGENTS.

Tangent 1 Degree.

M	0″	10″	20″	30″	40″	50′		Diff.
0	8.241921	8.243126	8.244328	8.245526	8.246721	8.247913	59	1197
1	8.249101	8.250287	8.251469	8.252648	8.253823	8.254996	58	1177
2	8.256165	8.257331	8.258494	8.259654	8.260811	8.261965	57	1158
3	8.263115	8.264263	8.265408	8.266549	8.267688	8.268824	56	1140
4	8.269956	8.271086	8.272213	8.273337	8.274458	8.275576	55	1122
5	8.276691	8.277804	8.278913	8.280020	8.281124	8.282225	54	1105
6	8.283323	8.284419	8.285512	8.286602	8.287689	8.288774	53	1089
7	8.289856	8.290935	8.292012	8.293086	8.294157	8.295226	52	1073
8	8.296292	8.297355	8.298416	8.299474	8.300530	8.301583	51	1057
9	8.302633	8.303682	8.304727	8.305770	8.306811	8.307849	50	1042
10	8.308884	8.309917	8.310948	8.311976	8.313002	8.314025	49	1027
11	8.315046	8.316065	8.317081	8.318095	8.319106	8.320115	48	1013
12	8.321122	8.322127	8.323129	8.324128	8.325126	8.326121	47	999
13	8.327114	8.328105	8.329093	8.330080	8.331064	8.332045	46	985
14	8.333025	8.334002	8.334977	8.335950	8.336921	8.337890	45	972
15	8.338856	8.339821	8.340783	8.341743	8.342701	8.343657	44	959
16	8.344610	8,345562	8.346512	8.347459	8.348405	8.349348	43	946
17	8.350289	8.351229	8.352166	8.353101	8.354035	8.354966	42	934
18	8.355895	8.356823	8.357748	8.358671	8.359593	8.360512	41	922
19	8.361430	8.362345	8.363259	8.364171	8.365080	8.365988	40	911
20	8.366894	8.367799	8.368701	8.369601	8.370500	8.371397	39	899
21	8.372291	8.373184	8.374076	8.374965	8.375853	8.376738	38	888
22	8.377622	8.378504	8.379385	8.380263	8.381140	8.382015	37	878
23	8.382889	8.383760	8.384630	8.385498	8.386364	8.387229	36	867
24	8.388092	8.388953	8.389812	8.390670	8.391526	8.392381	35	857
25	8.393234	8.394085	8.394934	8.395782	8.396628	8.397472	34	847
26	8.398315	8.399156	8.399996	8.400834	8.401670	8.402505	33	837
27	8.403338	8.404170	8.405000	8.405828	8.406655	8.407480	32	828
28	8.408304	8.409126	8.409946	8.410765	8.411583	8.412399	31	818
29	8.413213	8.414026	8.414837	8.415647	8.416456	8.417262	30	809
30	8.418068	8.418872	8.419674	8.420475	8.421274	8.422072	29	800
31	8.422869	8.423664	8.424458	8.425250	8.426040	8.426830	28	791
32	8.427618	8.428404	8.429189	8.429973	8.430755	8.431536	27	783
33	8.432315	8.433093	8.433870	8.434645	8.435419	8.436191	26	775
34	8.436962	8.437732	8.438500	8.439267	8.440033	8.440797	25	766
35	8.441560	8.442322	8.443082	8.443841	8.444599	8.445355	24	758
36	8.446110	8.446864	8.447616	8.448367	8.449117	8.449866	23	750
37	8.450613	8.451359	8.452104	8.452847	8.453589	8.454330	22	743
38	8.455070	8.455808	8.456545	8.457281	8.458016	8.458749	21	735
39	8.459481	8.460212	8.460942	8.461670	8.462398	8.463124	20	728
40	8.463849	8.464572	8.465295	8.466016	8.466736	8.467455	19	721
41	8.468172	8.468889	8.469604	8.470318	8.471031	8.471743	18	714
42	8.472454	8.473163	8.473871	8.474579	8.475285	8.475990	17	707
43	8.476693	8.477396	8.478097	8.478798	8.479497	8.480195	16	700
44	8.480892	8.481588	8.482283	8.482976	8.483669	8.484360	15	693
45	8.485050	8.485740	8.486428	8.487115	8.487801	8.488486	14	687
46	8.489170	8.489852	8.490534	8.491215	8.491894	8.492573	13	680
47	8.493250	8.493927	8.494602	8.495276	8.495949	8.496622	12	674
48	8.497293	8.497963	8.498632	8.499300	8.499967	8.500633	11	668
49	8.501298	8.501962	8.502625	8.503287	8.503948	8.504608	10	661
50	8.505267	8.505925	8.506582	8.507238	8.507893	8.508547	9	656
51	8.509200	8.509852	8.510503	8.511153	8.511802	8.512451	8	650
52	8.513098	8.513744	8.514389	8.515034	8.515677	8.516319	7	644
53	8.516961	8.517602	8.518241	8.518880	8.519517	8.520154	6	638
54	8.520790	8.521425	8.522059	8.522692	8.523324	8.523956	5	633
55	8.524586	8.525215	8.525844	8.526472	8.527098	8.527724	4	627
56	8.528349	8.528973	8.529596	8.530218	8.530840	8.531460	3	622
57	8.532080	8.532698	8.533316	8.533933	8.534549	8.535164	2	616
58	8.535779	8.536392	8.537005	8.537616	8.538227	8.538837	1	611
59	8.539447	8.540055	8.540662	8.541269	8.541875	8.542480	0	606
	60″	50″	40″	30″	20″	10″	M	

Co-tangent 88 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

0 Degree.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	0.000000		10.000000	00	0.000000		Infinite.	10.000000	Infinite.	60
1	6.463726	501717	10.000000	00	6.463726	501717	13.536274	10.000000	13.536274	59
2	6.764756	293485	10.000000	00	6.764756	293485	13.235244	10.000000	13.235244	58
3	6.940847	208231	10.000000	00	6.940847	208231	13.059153	10.000000	13.059153	57
4	7.065786	161517	10.000000	00	7.065786	161517	12.934214	10.000000	12.931214	56
5	7.162696	131968	10.000000	00	7.162696	131969	12.837304	10.000000	12.837304	55
6	7.241877	111578	9.999999	00	7.241878	111578	12.758122	10.000001	12.758123	54
7	7.308824	96653	9.999999	00	7.308825	96653	12.691175	10.000001	12.691176	53
8	7.366816	85254	9.999999	00	7.366817	85254	12.633183	10.000001	12.633184	52
9	7.417968	76262	9.999999	01	7.417970	76263	12.582030	10.000001	12.582032	51
10	7.463726	68988	9.999998	00	7.463727	68988	12.536273	10.000002	12.536274	50
11	7.505118	62981	9.999998	01	7.505120	62981	12.494880	10.000002	12.494882	49
12	7.542906	57936	9.999997	00	7.542909	57937	12.457091	10.000003	12.457094	48
13	7.577668	53641	9.999997	01	7.577672	53642	12.422328	10.000003	12.422332	47
14	7.609853	49938	9.999996	00	7.609857	49939	12.390143	10.000004	12.390147	46
15	7.639816	46714	9.999996	01	7.639820	46715	12.360180	10.000004	12.360184	45
16	7.667845	43881	9.999995	00	7.667849	43882	12.332151	10.000005	12.332155	44
17	7.694173	41372	9.999995	01	7.694179	41373	12.305821	10.000005	12.305827	43
18	7.718997	39135	9.999994	01	7.719003	39136	12.280997	10.000006	12.281003	42
19	7.742478	37127	9.999993	00	7.742484	37128	12.257516	10.000007	12.257522	41
20	7.764754	35315	9.999993	01	7.764761	35313	12.235239	10.000007	12.235246	40
21	7.785943	33672	9.999992	01	7.785951	33673	12.214049	10.000008	12.214057	39
22	7.806146	32175	9.999991	01	7.806155	32176	12.193845	10.000009	12.193854	38
23	7.825451	30805	9.999990	01	7.825460	30807	12.174540	10.000010	12.174549	37
24	7.843934	29547	9.999989	01	7.843944	29549	12.156056	10.000011	12.156066	36
25	7.861662	28388	9.999989	00	7.861674	28390	12.138326	10.000011	12.138338	35
26	7.878695	27317	9.999988	01	7.878708	27318	12.121292	10.000012	12.121305	34
27	7.895085	26323	9.999987	01	7.895099	26325	12.104901	10.000013	12.104915	33
28	7.910879	25399	9.999986	01	7.910894	25401	12.089106	10.000014	12.089121	32
29	7.926119	24538	9.999985	01	7.926134	24540	12.073866	10.000015	12.073881	31
30	7.940842	23733	9.999983	03	7.940858	23735	12.059142	10.000017	12.059158	30
31	7.955082	22980	9.999982	01	7.955100	22982	12.044900	10.000018	12.044918	29
32	7.968870	22273	9.999981	01	7.968889	22275	12.031111	10.000019	12.031130	28
33	7.982233	21608	9.999980	01	7.982253	21610	12.017747	10.000020	12.017767	27
34	7.995198	20981	9.999979	03	7.995219	20983	12.004781	10.000021	12.004802	26
35	8.007787	20390	9.999977	01	8.007809	20392	11.992191	10.000023	11.992213	25
36	8.020021	19831	9.999976	01	8.020045	19833	11.979955	10.000024	11.979979	24
37	8.031919	19302	9.999975	01	8.031945	19305	11.968055	10.000025	11.968081	23
38	8.043501	18801	9.999973	03	8.043527	18803	11.956473	10.000027	11.956499	22
39	8.054781	18325	9.999972	01	8.054809	18327	11.945191	10.000028	11.945219	21
40	8.065776	17872	9.999971	03	8.065806	17875	11.934194	10.000029	11.934224	20
41	8.076500	17441	9.999969	01	8.076531	17444	11.923469	10.000031	11.923500	19
42	8.086965	17031	9.999968	03	8.086997	17034	11.913003	10.000032	11.913035	18
43	8.097183	16639	9.999966	03	8.097217	16642	11.902783	10.000034	11.902817	17
44	8.107167	16265	9.999964	01	8.107202	16268	11.892798	10.000036	11.892833	16
45	8.116926	15908	9.999963	03	8.116963	15911	11.883037	10.000037	11.883074	15
46	8.126471	15566	9.999961	03	8.126510	15568	11.873490	10.000039	11.873529	14
47	8.135810	15238	9.999959	01	8.135851	15241	11.864149	10.000041	11.864190	13
48	8.144953	14924	9.999958	03	8.144996	14927	11.855004	10.000042	11.855047	12
49	8.153907	14622	9.999956	03	8.153952	14625	11.846048	10.000044	11.846093	11
50	8.162681	14333	9.999954	03	8.162727	14336	11.837273	10.000046	11.837319	10
51	8.171280	14054	9.999952	03	8.171328	14057	11.828672	10.000048	11.828720	9
52	8.179713	13786	9.999950	03	8.179763	13790	11.820237	10.000050	11.820287	8
53	8.187985	13529	9.999948	03	8.188036	13532	11.811964	10.000052	11.812015	7
54	8.196102	13280	9.999946	03	8.196156	13284	11.803844	10.000054	11.803898	6
55	8.204070	13041	9.999944	03	8.204126	13044	11.795874	10.000056	11.795930	5
56	8.211895	12810	9.999942	03	8.211953	12814	11.788047	10.000058	11.788105	4
57	8.219581	12587	9.999940	03	8.219641	12591	11.780359	10.000060	11.780419	3
58	8.227134	12372	9.999938	03	8.227195	12376	11.772805	10.000062	11.772866	2
59	8.234557	12164	9.999936	03	8.234621	12168	11.765379	10.000064	11.765443	1
60	8.241855		9.999934		8.241922		11.758078	10.000066	11.758145	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

89 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

1 Degree.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	8.241855	11963	9.999934	03	8.241921	11967	11.758079	10.000066	11.758145	60
1	8.249033	11768	9.999932	05	8.249102	11772	11.750898	10.000068	11.750967	59
2	8.256094	11580	9.999929	03	8.256165	11584	11.743835	10.000071	11.743906	58
3	8.263042	11397	9.999927	03	8.263115	11402	11.736885	10.000073	11.736958	57
4	8.269881	11221	9.999925	05	8.269956	11225	11.730044	10.000075	11.730119	56
5	8.276614	11050	9.999922	03	8.276691	11054	11.723309	10.000078	11.723386	55
6	8.283243	10883	9.999920	05	8.283323	10887	11.716677	10.000080	11.716757	54
7	8.289773	10722	9.999918	03	8.289856	10726	11.710144	10.000082	11.710227	53
8	8.296207	10565	9.999915	05	8.296292	10570	11.703708	10.000085	11.703793	52
9	8.302546	10413	9.999913	03	8.302634	10418	11.697366	10.000087	11.697454	51
10	8.308794	10266	9.999910	05	8.308884	10270	11.691116	10.000090	11.691206	50
11	8.314954	10122	9.999907	03	8.315046	10126	11.684954	10.000093	11.685046	49
12	8.321027	9982	9.999905	05	8.321122	9987	11.678878	10.000095	11.678973	48
13	8.327016	9847	9.999902	05	8.327114	9851	11.672886	10.000098	11.672984	47
14	8.332924	9714	9.999899	03	8.333025	9719	11.666975	10.000101	11.667076	46
15	8.338753	9586	9.999897	05	8.338856	9590	11.661144	10.000103	11.661247	45
16	8.344504	9460	9.999894	05	8.344610	9465	11.655390	10.000106	11.655496	44
17	8.350181	9338	9.999891	05	8.350289	9343	11.649711	10.000109	11.649819	43
18	8.355783	9219	9.999888	05	8.355895	9224	11.644105	10.000112	11.644217	42
19	8.361315	9103	9.999885	05	8.361430	9108	11.638570	10.000115	11.638685	41
20	8.366777	8990	9.999882	05	8.366895	8995	11.633105	10.000118	11.633223	40
21	8.372171	8880	9.999879	05	8.372292	8885	11.627708	10.000121	11.627829	39
22	8.377499	8772	9.999876	05	8.377622	8777	11.622378	10.000124	11.622501	38
23	8.382762	8667	9.999873	05	8.382889	8672	11.617111	10.000127	11.617238	37
24	8.387962	8564	9.999870	05	8.388092	8570	11.611908	10.000130	11.612038	36
25	8.393101	8464	9.999867	05	8.393234	8470	11.606766	10.000133	11.606899	35
26	8.398179	8366	9.999864	05	8.398315	8371	11.601685	10.000136	11.601821	34
27	8.403199	8271	9.999861	05	8.403338	8276	11.596662	10.000139	11.596801	33
28	8.408161	8177	9.999858	07	8.408304	8182	11.591696	10.000142	11.591839	32
29	8.413068	8086	9.999854	05	8.413213	8091	11.586787	10.000146	11.586932	31
30	8.417919	7996	9.999851	05	8.418068	8002	11.581932	10.000149	11.582081	30
31	8.422717	7909	9.999848	07	8.422869	7914	11.577131	10.000152	11.577283	29
32	8.427462	7823	9.999844	05	8.427618	7829	11.572382	10.000156	11.572538	28
33	8.432156	7740	9.999841	05	8.432315	7745	11.567685	10.000159	11.567844	27
34	8.436800	7657	9.999838	07	8.436962	7663	11.563038	10.000162	11.563200	26
35	8.441394	7577	9.999834	05	8.441560	7583	11.558440	10.000166	11.558606	25
36	8.445941	7499	9.999831	07	8.446110	7505	11.553890	30.000169	11.554059	24
37	8.450440	7422	9.999827	07	8.450613	7428	11.549387	10.000173	11.549560	23
38	8.454893	7346	9.999824	05	8.455070	7352	11.544930	10.000176	11.545107	22
39	8.459301	7273	9.999820	07	8.459481	7279	11.540519	10.000180	11.540699	21
40	8.463665	7200	9.999816	07	8.463849	7206	11.536151	10.000184	11.536335	20
41	8.467985	7129	9.999813	05	8.468172	7135	11.531828	10.000187	11.532015	19
42	8.472263	7060	9.999809	07	8.472454	7066	11.527546	10.000191	11.527737	18
43	8.476498	6991	9.999805	07	8.476693	6998	11.523307	10.000195	11.523502	17
44	8.480693	6924	9.999801	07	8.480892	6931	11.519108	10.000199	11.519307	16
45	8.484848	6859	9.999797	07	8.485050	6865	11.514950	10.000203	11.515152	15
46	8.488963	6794	9.999794	05	8.489170	6801	11.510830	10.000206	11.511037	14
47	8.493040	6731	9.999790	07	8.493250	6738	11.506750	10.000210	11.506960	13
48	8.497078	6669	9.999786	07	8.497293	6676	11.502707	10.000214	11.502922	12
49	8.501080	6608	9.999782	07	8.501298	6615	11.498702	10.000218	11.498920	11
50	8.505045	6548	9.999778	07	8.505267	6555	11.494733	10.000222	11.494955	10
51	8.508974	6489	9.999774	08	8.509200	6496	11.490800	10.000226	11.491026	9
52	8.512867	6432	9.999769	07	8.513098	6439	11.486902	10.000231	11.487133	8
53	8.516726	6375	9.999765	07	8.516961	6382	11.483039	10.000235	11.483274	7
54	8.520551	6319	9.999761	07	8.520790	6326	11.479210	10.000239	11.479449	6
55	8.524343	6264	9.999757	07	8.524586	6272	11.475414	10.000243	11.475657	5
56	8.528102	6211	9.999753	08	8.528349	6218	11.471651	10.000247	11.471898	4
57	8.531928	6158	9.999748	07	8.532080	6165	11.467920	10.000252	11.468172	3
58	8.535523	6106	9.999744	07	8.535779	6113	11.464221	10.000256	11.464477	2
59	8.[illegible]39[illegible]86	6055	9.999740	08	8.539447	6062	11.460553	10.000260	11.460814	1
60	8.542819		9.999735		8.543084		11.456916	10.000265	11.457181	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

88 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

2 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	8.542819	6004	9.999735	07	8.543084	6012	11.456916	10.000265	11.457181	60
1	8.546422	5955	9.999731	07	8.546691	5962	11.453309	10.000269	11.453578	59
2	8.549995	5906	9.999726	08	8.550268	5914	11.449732	10.000274	11.450005	58
3	8.553539	5858	9.999722	08	8.553817	5866	11.446183	10.000278	11.446461	57
4	8.557054	5811	9.999717	07	8.557336	5819	11.442664	10.000283	11.442946	56
5	8.560540	5765	9.999713	08	8.560828	5773	11.439172	10.000287	11.439460	55
6	8.563999	5719	9.999708	07	8.564291	5727	11.435709	10.000292	11.436001	54
7	8.567431	5674	9.999704	08	8.567727	5682	11.432273	10.000296	11.432569	53
8	8.570836	5630	9.999699	08	8.571137	5638	11.428863	10.000301	11.429164	52
9	8.574214	5587	9.999694	08	8.574520	5595	11.425480	10.000306	11.425786	51
10	8.577566	5544	9.999689	07	8.577877	5552	11.422123	10.000311	11.422434	50
11	8.580892	5502	9.999685	08	8.581208	5510	11.418792	10.000315	11.419108	49
12	8.584193	5460	9.999680	08	8.584514	5468	11.415486	10.000320	11.415807	48
13	8.587469	5419	9.999675	08	8.587795	5427	11.412205	10.000325	11.412531	47
14	8.590721	5379	9.999670	08	8.591051	5387	11.408949	10.000330	11.409279	46
15	8.593948	5339	9.999665	08	8.594283	5347	11.405717	10.000335	11.406052	45
16	8.597152	5300	9.999660	08	8.597492	5308	11.402508	10.000340	11.402848	44
17	8.600332	5261	9.999655	08	8.600677	5270	11.399323	10.000345	11.399668	43
18	8.603489	5223	9.999650	08	8.603839	5232	11.396161	10.000350	11.396511	42
19	8.606623	5186	9.999645	08	8.606978	5194	11.393022	10.000355	11.393377	41
20	8.609734	5149	9.999640	08	8.610094	5158	11.389906	10.000360	11.390266	40
21	8.612823	5112	9.999635	10	8.613189	5121	11.386811	10.000365	11.387177	39
22	8.615891	5076	9.999629	08	8.616262	5085	11.383738	10.000371	11.384109	38
23	8.618937	5041	9.999624	08	8.619313	5050	11.380687	10.000376	11.381063	37
24	8.621962	5006	9.999619	08	8.622343	5015	11.377657	10.000381	11.378038	36
25	8.624965	4972	9.999614	10	8.625352	4981	11.374648	10.000386	11.375035	35
26	8.627948	4938	9.999608	08	8.628340	4947	11.371660	10.000392	11.372052	34
27	8.630911	4904	9.999603	10	8.631308	4913	11.368692	10.000397	11.369089	33
28	8.633854	4871	9.999597	08	8.634256	4880	11.365744	10.000403	11.366146	32
29	8.636776	4839	9.999592	08	8.637184	4848	11.362816	10.000408	11.363224	31
30	8.639680	4806	9.999586	10	8.640093	4816	11.359907	10.000414	11.360320	30
31	8.642563	4775	9.999581	10	8.642982	4784	11.357018	10.000419	11.357437	29
32	8.645428	4743	9.999575	08	8.645853	4753	11.354147	10.000425	11.354572	28
33	8.648274	4712	9.999570	10	8.648704	4722	11.351296	10.000430	11.351726	27
34	8.651102	4682	9.999564	10	8.651537	4691	11.348463	10.000436	11.348898	26
35	8.653911	4652	9.999558	08	8.654352	4661	11.345648	10.000442	11.346089	25
36	8.656702	4622	9.999553	10	8.657149	4631	11.342851	10.000447	11.343298	24
37	8.659475	4592	9.999547	10	8.659928	4602	11.340072	10.000453	11.340525	23
38	8.662230	4563	9.999541	10	8.662689	4573	11.337311	10.000459	11.337770	22
39	8.664968	4535	9.999535	10	8.665433	4544	11.334567	10.000465	11.335032	21
40	8.667689	4506	9.999529	08	8.668160	4516	11.331840	10.000471	11.332311	20
41	8.670393	4479	9.999524	10	8.670870	4488	11.329130	10.000476	11.329607	19
42	8.673080	4451	9.999518	10	8.673563	4461	11.326437	10.000482	11.326920	18
43	8.675751	4424	9.999512	10	8.676239	4434	11.323761	10.000488	11.324249	17
44	8.678405	4397	9.999506	10	8.678900	4407	11.321100	10.000494	11.321595	16
45	8.681043	4370	9.999500	10	8.681544	4380	11.318456	10.000500	11.318957	15
46	8.683665	4344	9.999493	12	8.684172	4354	11.315828	10.000507	11.316335	14
47	8.686272	4318	9.999487	10	8.686784	4328	11.313216	10.000513	11.313728	13
48	8.688863	4292	9.999481	10	8.689381	4303	11.310619	10.000519	11.311137	12
49	8.691438	4267	9.999475	10	8.691963	4277	11.308037	10.000525	11.308562	11
50	8.693998	4242	9.999469	12	8.694529	4252	11.305471	10.000531	11.306002	10
51	8.696543	4217	9.999463	10	8.697081	4228	11.302919	10.000537	11.303457	9
52	8.699073	4192	9.999456	10	8.699617	4203	11.300383	10.000544	11.300927	8
53	8.701589	4168	9.999450	10	8.702139	4179	11.297861	10.000550	11.298411	7
54	8.704090	4144	9.999443	12	8.704646	4155	11.295354	10.000557	11.295910	6
55	8.706577	4121	9.999437	10	8.707140	4132	11.292860	10.000563	11.293423	5
56	8.709049	4097	9.999431	12	8.709618	4108	11.290382	10.000569	11.290951	4
57	8.711507	4074	9.999424	10	8.712083	4085	11.287917	10.000576	11.288493	3
58	8.713952	4052	9.999418	12	8.714534	4062	11.285466	10.000582	11.286048	2
59	8.716383	4029	9.999411	12	8.716972	4040	11.283028	10.000589	11.283617	1
60	8.718800		9.999404		8.719396		11.280604	10.000596	11.281200	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

87 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

3 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	8.718800	4006	9.999404	10	8.719396	4017	11.280604	10.000596	11.281200	60
1	8.721204	3984	9.999398	12	8.721806	3995	11.278194	10.000602	11.278796	59
2	8.723595	3962	9.999391	12	8.724204	3974	11.275796	10.000609	11.276405	58
3	8.725972	3941	9.999384	10	8.726588	3952	11.273412	10.000616	11.274028	57
4	8.728337	3919	9.999378	12	8.728959	3931	11.271041	10.000622	11.271663	56
5	8.730688	3898	9.999371	12	8.731317	3909	11.268683	10.000629	11.269312	55
6	8.733027	3877	9.999364	12	8.733663	3889	11.266337	10.000636	11.266973	54
7	8.735354	3857	9.999357	12	8.735996	3868	11.264004	10.000643	11.264646	53
8	8.737667	3836	9.999350	12	8.738317	3848	11.261683	10.000650	11.262333	52
9	8.739969	3816	9.999343	12	8.740626	3827	11.259374	10.000657	11.260031	51
10	8.742259	3796	9.999336	12	8.742922	3807	11.257078	10.000664	11.257741	50
11	8.744536	3776	9.999329	12	8.745207	3787	11.254793	10.000671	11.255464	49
12	8.746802	3756	9.999322	12	8.747479	3768	11.252521	10.000678	11.253198	48
13	8.749055	3737	9.999315	12	8.749740	3749	11.250260	10.000685	11.250945	47
14	8.751297	3717	9.999308	12	8.751989	3729	11.248011	10.000692	11.248703	46
15	8.753528	3698	9.999301	12	8.754227	3710	11.245773	10.000699	11.246472	45
16	8.755747	3679	9.999294	13	8.756453	3692	11.243547	10.000706	11.244253	44
17	8.757955	3661	9.999287	12	8.758668	3673	11.241332	10.000713	11.242045	43
18	8.760151	3642	9.999279	12	8.760872	3655	11.239128	10.000721	11.239849	42
19	8.762337	3624	9.999272	12	8.763065	3636	11.236935	10.000728	11.237663	41
20	8.764511	3606	9.999265	13	8.765246	3618	11.234754	10.000735	11.235489	40
21	8.766675	3588	9.999257	12	8.767417	3600	11.232583	10.000743	11.233325	39
22	8.768828	3570	9.999250	13	8.769578	3583	11.230422	10.000750	11.231172	38
23	8.770970	3553	9.999242	12	8.771727	3565	11.228273	10.000758	11.229030	37
24	8.773101	3535	9.999235	13	8.773866	3548	11.226134	10.000765	11.226899	36
25	8.775223	3518	9.999227	12	8.775995	3531	11.224005	10.000773	11.224777	35
26	8.777333	3501	9.999220	13	8.778114	3514	11.221886	10.000780	11.222667	34
27	8.779434	3484	9.999212	12	8.780222	3497	11.219778	10.000788	11.220566	33
28	8.781524	3467	9.999205	13	8.782320	3480	11.217680	10.000795	11.218476	32
29	8.783605	3451	9.999197	13	8.784408	3464	11.215592	10.000803	11.216395	31
30	8.785675	3434	9.999189	13	8.786486	3447	11.213514	10.000811	11.214325	30
31	8.787736	3418	9.999181	12	8.788554	3431	11.211446	10.000819	11.212264	29
32	8.789787	3402	9.999174	13	8.790613	3415	11.209387	10.000826	11.210213	28
33	8.791828	3386	9.999166	13	8.792662	3399	11.207338	10.000834	11.208172	27
34	8.793859	3370	9.999158	13	8.794701	3383	11.205299	10.000842	11.206141	26
35	8.795881	3354	9.999150	13	8.796731	3368	11.203269	10.000850	11.204119	25
36	8.797894	3339	9.999142	13	8.798752	3352	11.201248	10.000858	11.202106	24
37	8.799897	3323	9.999134	13	8.800763	3337	11.199237	10.000866	11.200103	23
38	8.801892	3308	9.999126	13	8.802765	3322	11.197235	10.000874	11.198108	22
39	8.803876	3293	9.999118	13	8.804758	3306	11.195242	10.000882	11.196124	21
40	8.805852	3278	9.999110	13	8.806742	3292	11.193258	10.000890	11.194148	20
41	8.807819	3263	9.999102	13	8.808717	3277	11.191283	10.000898	11.192181	19
42	8.809777	3249	9.999094	13	8.810683	3262	11.189317	10.000906	11.190223	18
43	8.811726	3234	9.999086	15	8.812641	3248	11.187359	10.000914	11.188274	17
44	8.813667	3219	9.999077	13	8.814589	3233	11.185411	10.000923	11.186333	16
45	8.815599	3205	9.999069	13	8.816529	3219	11.183471	10.000931	11.184401	15
46	8.817522	3191	9.999061	15	8.818461	3205	11.181539	10.000939	11.182478	14
47	8.819436	3177	9.999053	13	8.820384	3191	11.179616	10.000947	11.180564	13
48	8.821343	3163	9.999044	13	8.822298	3177	11.177702	10.000956	11.178657	12
49	8.823240	3149	9.999036	15	8.824205	3163	11.175795	10.000964	11.176760	11
50	8.825130	3135	9.999027	13	8.826103	3150	11.173897	10.000973	11.174870	10
51	8.827011	3122	9.999019	15	8.827992	3136	11.172008	10.000981	11.172989	9
52	8.828884	3108	9.999010	13	8.829874	3123	11.170126	10.000990	11.171116	8
53	8.830749	3095	9.999002	15	8.831748	3109	11.168252	10.000998	11.169251	7
54	8.832607	3082	9.998993	15	8.833613	3096	11.166387	10.001007	11.167393	6
55	8.834456	3069	9.998984	13	8.835471	3083	11.164529	10.001016	11.165544	5
56	8.836297	3056	9.998976	15	8.837321	3070	11.162679	10.001024	11.163703	4
57	8.838130	3043	9.998967	15	8.839163	3057	11.160837	10.001033	11.161870	3
58	8.839956	3030	9.998958	13	8.840998	3045	11.159002	10.001042	11.160044	2
59	8.841774	3017	9.998950	15	8.842825	3032	11.157175	10.001050	11.158226	1
60	8.843585		9.998941		8.844644		11.155356	10.001059	11.156415	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

86 Degrees.

4 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	8.843585	3005	9.998941	15	8.844644	3019	11.155356	10.001059	11.156415	60
1	8.845387	2992	9.998932	15	8.846455	3007	11.153545	10.001068	11.154613	59
2	8.847183	2980	9.998923	15	8.848260	2995	11.151740	10.001077	11.152817	58
3	8.848971	2967	9.998914	15	8.850057	2982	11.149943	10.001086	11.151029	57
4	8.850751	2955	9.998905	15	8.851846	2970	11.148154	10.001095	11.149249	56
5	8.852525	2943	9.998896	15	8.853628	2958	11.146372	10.001104	11.147475	55
6	8.854291	2931	9.998887	15	8.855403	2946	11.144597	10.001113	11.145709	54
7	8.856049	2919	9.998878	15	8.857171	2935	11.142829	10.001122	11.143951	53
8	8.857801	2908	9.998869	15	8.858932	2923	11.141068	10.001131	11.142199	52
9	8.859546	2896	9.998860	15	8.860686	2911	11.139314	10.001140	11.140454	51
10	8.861283	2884	9.998851	17	8.862433	2900	11.137567	10.001149	11.138717	50
11	8.863014	2873	9.998841	15	8.864173	2888	11.135827	10.001159	11.136986	49
12	8.864738	2861	9.998832	15	8.865906	2877	11.134094	10.001168	11.135262	48
13	8.866455	2850	9.998823	17	8.867632	2866	11.132368	10.001177	11.133545	47
14	8.868165	2839	9.998813	15	8.869351	2854	11.130649	10.001187	11.131835	46
15	8.869868	2828	9.998804	15	8.871064	2843	11.128936	10.001196	11.130132	45
16	8.871565	2817	9.998795	17	8.872770	2832	11.127230	10.001205	11.128435	44
17	8.873255	2806	9.998785	15	8.874469	2821	11.125531	10.001215	11.126745	43
18	8.874938	2795	9.998776	17	8.876162	2811	11.123838	10.001224	11.125062	42
19	8.876615	2784	9.998766	15	8.877849	2800	11.122151	10.001234	11.123385	41
20	8.878285	2773	9.998757	17	8.879529	2789	11.120471	10.001243	11.121715	40
21	8.879949	2763	9.998747	17	8.881202	2779	11.118798	10.001253	11.120051	39
22	8.881607	2752	9.998738	15	8.882869	2768	11.117131	10.001262	11.118393	38
23	8.883258	2742	9.998728	17	8.884530	2758	11.115470	10.001272	11.116742	37
24	8.884903	2731	9.998718	17	8.886185	2747	11.113815	10.001282	11.115097	36
25	8.886542	2721	9.998708	15	8.887833	2737	11.112167	10.001292	11.113458	35
26	8.888174	2711	9.998699	17	8.889476	2727	11.110524	10.001301	11.111826	34
27	8.889801	2700	9.998689	17	8.891112	2717	11.108888	10.001311	11.110199	33
28	8.891421	2690	9.998679	17	8.892742	2707	11.107258	10.001321	11.108579	32
29	8.893035	2680	9.998669	17	8.894366	2697	11.105634	10.001331	11.106965	31
30	8.894643	2670	9.998659	17	8.895984	2687	11.104016	10.001341	11 105357	30
31	8.896246	2660	9.998649	17	8.897596	2677	11.102404	10.001351	11.103754	29
32	8.897842	2651	9.998639	17	8.899203	2667	11.100797	10.001361	11.102158	28
33	8.899432	2641	9.998629	17	8.900803	2658	11.099197	10.001371	11.100568	27
34	8.901017	2631	9.998619	17	8.902398	2648	11.097602	10.001381	11.098983	26
35	8.902596	2622	9.998609	17	8.903987	2638	11.096013	10.001391	11.097404	25
36	8.904169	2612	9.998599	17	8.905570	2629	11.094430	10.001401	11.095831	24
37	8.905736	2603	9.998589	18	8.907147	2620	11.092853	10.001411	11.094264	23
38	8.907297	2593	9.998578	17	8.908719	2610	11.091281	10.001422	11.092703	22
39	8.908853	2584	9.998568	17	8.910285	2601	11.089715	10.001432	11.091147	21
40	8.910404	2575	9.998558	17	8.911846	2592	11.088154	10.001442	11.089596	20
41	8.911949	2566	9.998548	18	8.913401	2583	11.086599	10.001452	11.088051	19
42	8.913488	2556	9.998537	17	8.914951	2574	11.085049	10.001463	11.086512	18
43	8.915022	2547	9.998527	18	8.916495	2565	11.083505	10.001473	11.084978	17
44	8.916550	2538	9.998516	17	8.918034	2556	11.081966	10.001484	11.083450	16
45	8.918073	2529	9.998506	18	8.919568	2547	11.080432	10.001494	11.081927	15
46	8.919591	2520	9.998495	17	8.921096	2538	11.078904	10.001505	11.080409	14
47	8.921103	2512	9.998485	18	8.922619	2530	11.077381	10.001515	11.078897	13
48	8.922610	2503	9.998474	17	8.924136	2521	11.075864	10.001526	11.077390	12
49	8.924112	2494	9.998464	18	8.925649	2512	11.074351	10.001536	11.075888	11
50	8.925609	2486	9.998453	18	8.927156	2503	11.072844	10.001547	11.074391	10
51	8.927100	2477	9.998442	18	8.928658	2495	11.071342	10.001558	11.072900	9
52	8.928587	2469	9.998431	17	8.930155	2486	11.069845	10.001569	11.071413	8
53	8.930068	2460	9.998421	18	8.931647	2478	11.068353	10.001579	11.069932	7
54	8.931544	2452	9.998410	18	8.933134	2470	11.066866	10.001590	11.068456	6
55	8.933015	2443	9.998399	18	8.934616	2461	11.065384	10.001601	11.066985	5
56	8.934481	2435	9.998388	18	8.936093	2453	11.063907	10.001612	11.065519	4
57	8.935942	2427	9.998377	18	8.937565	2445	11.062435	10.001623	11.064058	3
58	8.937398	2419	9.998366	18	8.939032	2437	11.060968	10.001634	11.062602	2
59	8.938850	2411	9.998355	18	8.940494	2429	11.059506	10.001645	11.061150	1
60	8.940296		9.998344		8.941952		11.058048	10.001656	11.059704	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

85 Degrees.

5 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	8.940296	2403	9.998344	18	8.941952	2421	11.058048	10.001656	11.059704	60
1	8.941738	2394	9.998333	18	8.943404	2413	11.056596	10.001667	11.058262	59
2	8.943174	2387	9.998322	18	8.944852	2405	11.055148	10.001678	11.056826	58
3	8.944606	2379	9.998311	18	8.946295	2397	11.053705	10.001689	11.055394	57
4	8.946034	2371	9.998300	18	8.947734	2390	11.052266	10.001700	11.053966	56
5	8.947456	2363	9.998289	20	8.949168	2382	11.050832	10.001711	11.052544	55
6	8.948874	2355	9.998277	18	8.950597	2374	11.049403	10.001723	11.051126	54
7	8.950287	2348	9.998266	18	8.952021	2366	11.047979	10.001734	11.049713	53
8	8.951696	2340	9.998255	20	8.953441	2359	11.046559	10.001745	11.048304	52
9	8.953100	2332	9.998243	18	8.954856	2351	11.045144	10.001757	11.046900	51
10	8.954499	2325	9.998232	20	8.956267	2344	11.043733	10.001768	11.045501	50
11	8.955894	2317	9.998220	18	8.957674	2336	11.042326	10.001780	11.044106	49
12	8.957284	2310	9.998209	20	8.959075	2329	11.040925	10.001791	11.042716	48
13	8.958670	2302	9.998197	18	8.960473	2322	11.039527	10.001803	11.041330	47
14	8.960052	2295	9.998186	20	8.961866	2314	11.038134	10.001814	11.039948	46
15	8.961429	2288	9.998174	18	8.963255	2307	11.036745	10.001826	11.038571	45
16	8.962801	2280	9.998163	29	8.964639	2300	11.035361	10.001837	11.037199	44
17	8.964170	2273	9.998151	20	8.966019	2293	11.033981	10.001849	11.035830	43
18	8.965534	2266	9.998139	18	8.967394	2286	11.032606	10.001861	11.034466	42
19	8.966893	2259	9.998128	20	8.968766	2279	11.031234	10.001872	11.033107	41
20	8.968249	2252	9.998116	20	8.970133	2271	11.029867	10.001884	11.031751	40
21	8.969600	2245	9.998104	20	8.971496	2265	11.028504	10.001896	11.030400	39
22	8.970947	2238	9.998092	20	8.972855	2257	11.027145	10.001908	11.029053	38
23	8.972289	2231	9.998080	20	8.974209	2251	11.025791	10.001920	11.027711	37
24	8.973628	2224	9.998068	20	8.975560	2244	11.024440	10.001932	11.026372	36
25	8.974962	2217	9.998056	20	8.976906	2237	11.023094	10.001944	11.025038	35
26	8.976293	2210	9.998044	20	8.978248	2230	11.021752	10.001956	11.023707	34
27	8.977619	2203	9.998032	20	8.979586	2223	11.020414	10.001968	11.022381	33
28	8.978941	2197	9.998020	20	8.980921	2217	11.019079	10.001980	11.021059	32
29	8.980259	2190	9.998008	20	8.982251	2210	11.017749	10.001992	11.019741	31
30	8.981573	2183	9.997996	20	8.983577	2204	11.016423	10.002004	11.018427	30
31	8.982883	2177	9.997984	20	8.984899	2197	11.015101	10.002016	11.017117	29
32	8.984189	2170	9.997972	22	8.986217	2191	11.013783	10.002028	11.015811	28
33	8.985491	2163	9.997959	20	8.987532	2184	11.012468	10.002041	11.014509	27
34	8.986789	2157	9.997947	20	8.988842	2178	11.011158	10.002053	11.013211	26
35	8.988083	2150	9.997935	22	8.990149	2171	11.009851	10.002065	11.011917	25
36	8.989374	2144	9.997922	20	8.991451	2165	11.008549	10.002078	11.010626	24
37	8.990660	2138	9.997910	22	8.992750	2158	11.007250	10.002090	11.009340	23
38	8.991943	2131	9.997897	20	8.994045	2152	11.005955	10.002103	11.008057	22
39	8.993222	2125	9.997885	22	8.995337	2146	11.004663	10.002115	11.006778	21
40	8.994497	2119	9.997872	20	8.996624	2140	11.003376	10.002128	11.005503	20
41	8.995768	2112	9.997860	22	8.997908	2134	11.002092	10.002140	11.004232	19
42	8.997036	2106	9.997847	20	8.999188	2127	11.000812	10.002153	11.002964	18
43	8.998299	2100	9.997835	22	9.000465	2121	10.999535	10.002165	11.001701	17
44	8.999560	2094	9.997822	22	9.001738	2115	10.998262	10.002178	11.000440	16
45	9.000816	2088	9.997809	20	9.003007	2109	10.996993	10.002191	10.999184	15
46	9.002069	2082	9.997797	22	9.004272	2103	10.995728	10.002203	10.997931	14
47	9.003318	2076	9.997784	22	9.005534	2097	10.994466	10.002216	10.996682	13
48	9.004563	2070	9.997771	22	9.006792	2091	10.993208	10.002229	10.995437	12
49	9.005805	2064	9.997758	22	9.008047	2085	10.991953	10.002242	10.994195	11
50	9.007044	2058	9.997745	22	9.009298	2079	10.990702	10.002255	10.992956	10
51	9.008278	2052	9.997732	22	9.010546	2074	10.989454	10.002268	10.991722	9
52	9.009510	2046	9.997719	22	9.011790	2068	10.988210	10.002281	10.990490	8
53	9.010737	2040	9.997706	22	9.013031	2062	10.986969	10.002294	10.989263	7
54	9.011962	2034	9.997693	22	9.014268	2056	10.985732	10.002307	10.988038	6
55	9.013182	2029	9.997680	22	9.015502	2051	10.984498	10.002320	10.986818	5
56	9.014400	2023	9.997667	22	9.016732	2045	10.983268	10.002333	10.985600	4
57	9.015613	2017	9.997654	22	9.017959	2039	10.982041	10.002346	10.984387	3
58	9.016824	2012	9.997641	22	9.019183	2034	10.980817	10.002359	10.983176	2
59	9.018031	2006	9.997628	23	9.020403	2028	10.979597	10.002372	10.981969	1
60	9.019235		9.997614		9.021620		10.978380	10.002386	10.980765	0
M	Co-sine.		Sine.		Co-tang.		Tang.	Co-sec.	Secant.	M

84 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

6 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.019235	2000	9.997614	22	9.021620	2023	10.978380	10.002386	10.980765	60
1	9.020435	1995	9.997601	22	9.022834	2017	10.977166	10.002399	10.979565	59
2	9.021632	1989	9.997588	23	9.024044	2011	10.975956	10.002412	10.978368	58
3	9.022825	1984	9.997574	22	9.025251	2006	10.974749	10.002426	10.977175	57
4	9.024010	1978	9.997561	23	9.026455	2001	10.973545	10.002439	10.975984	56
5	9.025203	1973	9.997547	22	9.027655	1995	10.972345	10.002453	10.974797	55
6	9.026386	1967	9.997534	23	9.028852	1990	10.971148	10.002466	10.973614	54
7	9.027567	1962	9.997520	22	9.030046	1985	10.969954	10.002480	10.972433	53
8	9.028744	1957	9.997507	23	9.031237	1979	10.968763	10.002493	10.971256	52
9	9.029918	1951	9.997493	22	9.032425	1974	10.967575	10.002507	10.970082	51
10	9.031089	1946	9.997480	23	9.033609	1969	10.966391	10.002520	10.968911	50
11	9.032257	1941	9.997466	23	9.034791	1964	10.965209	10.002534	10.967743	49
12	9.033421	1936	9.997452	22	9.035969	1958	10.964031	10.002548	10.966579	48
13	9.034582	1930	9.997439	23	9.037144	1953	10.962856	10.002561	10.965418	47
14	9.035741	1925	9.997425	23	9.038316	1948	10.961684	10.002575	10.964259	46
15	9.036896	1920	9.997411	23	9.039485	1943	10.960515	10.002589	10.963104	45
16	9.038048	1915	9.997397	23	9.040651	1938	10.959349	10.002603	10.961952	44
17	9.039197	1910	9.997383	23	9.041813	1933	10.958187	10.002617	10.960803	43
18	9.040342	1905	9.997369	23	9.042973	1928	10.957027	10.002631	10.959658	42
19	9.041485	1899	9.997355	23	9.044130	1923	10.955870	10.002645	10.958515	41
20	9.042625	1895	9.997341	23	9.045284	1918	10.954716	10.002659	10.957375	40
21	9.043762	1889	9.997327	23	9.046434	1913	10.953566	10.002673	10.956238	39
22	9.044895	1884	9.997313	23	9.047582	1908	10.952418	10.002687	10.955105	38
23	9.046026	1879	9.997299	23	9.048727	1903	10.951273	10.002701	10.953974	37
24	9.047154	1875	9.997285	23	9.049869	1898	10.950131	10.002715	10.952846	36
25	9.048279	1870	9.997271	23	9.051008	1893	10.948992	10.002729	10.951721	35
26	9.049400	1865	9.997257	25	9.052144	1889	10.947856	10.002743	10.950600	34
27	9.050519	1860	9.997242	23	9.053277	1884	10.946723	10.002758	10.949481	33
28	9.051635	1855	9.997228	23	9.054407	1879	10.945593	10.002772	10.948365	32
29	9.052749	1850	9.997214	25	9.055535	1874	10.944465	10.002786	10.947251	31
30	9.053859	1845	9.997199	23	9.056659	1870	10.943341	10.002801	10.946141	30
31	9.054966	1841	9.997185	25	9.057781	1865	10.942219	10.002815	10.945034	29
32	9.056071	1836	9.997170	23	9.058900	1860	10.941100	10.002830	10.943929	28
33	9.057172	1831	9.997156	25	9.060016	1855	10.939984	10.002844	10.942828	27
34	9.058271	1827	9.997141	23	9.061130	1851	10.938870	10.002859	10.941729	26
35	9.059367	1822	9.997127	25	9.062240	1846	10.937760	10.002873	10.940633	25
36	9.060460	1817	9.997112	23	9.063348	1842	10.936652	10.002888	10.939540	24
37	9.061551	1813	9.997098	25	9.064453	1837	10.935547	10.002902	10.938449	23
38	9.062639	1808	9.997083	25	9.065556	1833	10.934444	10.002917	10.937361	22
39	9.063724	1804	9.997068	25	9.066655	1828	10.933345	10.002932	10.936276	21
40	9.064806	1799	9.997053	23	9.067752	1824	10.932248	10.002947	10.935194	20
41	9.065885	1794	9.997039	25	9.068846	1819	10.931154	10.002961	10.934115	19
42	9.066962	1790	9.997024	25	9.069938	1815	10.930062	10.002976	10.933038	18
43	9.068036	1786	9.997009	25	9.071027	1810	10.928973	10.002991	10.931964	17
44	9.069107	1781	9.996994	25	9.072113	1806	10.927887	10.003006	10.930893	16
45	9.070176	1777	9.996979	25	9.073197	1802	10.926803	10.003021	10.929824	15
46	9.071242	1772	9.996964	25	9.074278	1797	10.925722	10.003036	10.928758	14
47	9.072306	1768	9.996949	25	9.075356	1793	10.924644	10.003051	10.927694	13
48	9.073366	1763	9.996934	25	9.076432	1789	10.923568	10.003066	10.926634	12
49	9.074424	1759	9.996919	25	9.077505	1784	10.922495	10.003081	10.925576	11
50	9.075480	1755	9.996904	25	9.078576	1780	10.921424	10.003096	10.924520	10
51	9.076533	1750	9.996889	25	9.079644	1776	10.920356	10.003111	10.923467	9
52	9.077583	1746	9.996874	27	9.080710	1772	10.919290	10.003126	10.922417	8
53	9.078631	1742	9.996858	25	9.081773	1767	10.918227	10.003142	10.921369	7
54	9.079676	1738	9.996843	25	9.082833	1763	10.917167	10.003157	10.920324	6
55	9.080719	1733	9.996828	27	9.083891	1759	10.916109	10.003172	10.919281	5
56	9.081759	1729	9.996812	25	9.084947	1755	10.915053	10.003188	10.918241	4
57	9.082797	1725	9.996797	25	9.086000	1751	10.914000	10.003203	10.917203	3
58	9.083832	1721	9.996782	27	9.087050	1747	10.912950	10.003218	10.916168	2
59	9.084864	1717	9.996766	25	9.088098	1743	10.911902	10.003234	10.915136	1
60	9.085894		9.996751		9.089144		10.910856	10.003249	10.914106	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

83 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

7 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.085894	1713	9.996751	27	9.089144	1738	10.910856	10.003249	10.914106	60
1	9.086922	1709	9.996735	25	9.090187	1735	10.909813	10.003265	10.913078	59
2	9.087947	1704	9.996720	27	9.091228	1731	10.908772	10.003280	10.912053	58
3	9.088970	1700	9.996704	27	9.092266	1727	10.907734	10.003296	10.911030	57
4	9.089990	1696	9.996688	25	9.093302	1723	10.906698	10.003312	10.910010	56
5	9.091008	1692	9.996673	27	9.094336	1719	10.905664	10.003327	10.908992	55
6	9.092024	1688	9.996657	27	9.095367	1715	10.904633	10.003343	10.907976	54
7	9.093037	1684	9.996641	27	9.096395	1711	10.903605	10.003359	10.906963	53
8	9.094047	1680	9.996625	25	9.097422	1707	10.902578	10.003375	10.905953	52
9	9.095056	1676	9.996610	27	9.098446	1703	10.901554	10.003390	10.904944	51
10	9.096062	1673	9.996594	27	9.099468	1699	10.900532	10.003406	10.903938	50
11	9.097065	1668	9.996578	27	9.100487	1695	10.899513	10.003422	10.902935	49
12	9.098066	1665	9.996562	27	9.101504	1691	10.898496	10.003438	10.901934	48
13	9.099065	1661	9.996546	27	9.102519	1687	10.897481	10.003454	10.900935	47
14	9.100062	1657	9.996530	27	9.103532	1684	10.896468	10.003470	10.899938	46
15	9.101056	1653	9.996514	27	9.104542	1680	10.895458	10.003486	10.898944	45
16	9.102048	1649	9.996498	27	9.105550	1676	10.894450	10.003502	10.897952	44
17	9.103037	1645	9.996482	28	9.106556	1672	10.893444	10.003518	10.896963	43
18	9.104025	1642	9.996465	27	9.107559	1669	10.892441	10.003535	10.895975	42
19	9.105010	1638	9.996449	27	9.108560	1665	10.891440	10.003551	10.894990	41
20	9.105992	1634	9.996433	27	9.109559	1661	10.890441	10.003567	10.894008	40
21	9.106973	1630	9.996417	28	9.110556	1658	10.889444	10.003583	10.893027	39
22	9.107951	1627	9.996400	27	9.111551	1654	10.888449	10.003600	10.892049	38
23	9.108927	1623	9.996384	27	9.112543	1650	10.887457	10.003616	10.891073	37
24	9.109901	1619	9.996368	28	9.113533	1647	10.886467	10.003632	10.890099	36
25	9.110873	1616	9.996351	27	9.114521	1643	10.885479	10.003649	10.889127	35
26	9.111842	1612	9.996335	28	9.115507	1639	10.884493	10.003665	10.888158	34
27	9.112809	1608	9.996318	27	9.116491	1636	10.883509	10.003682	10.887191	33
28	9.113774	1605	9.996302	28	9.117472	1632	10.882528	10.003698	10.886226	32
29	9.114737	1601	9.996285	27	9.118452	1629	10.881548	10.003715	10.885263	31
30	9.115698	1597	9.996269	28	9.119429	1625	10.880571	10.003731	10.884302	30
31	9.116656	1594	9.996252	28	9.120404	1622	10.879596	10.003748	10.883344	29
32	9.117613	1590	9.996235	27	9.121377	1618	10.878623	10.003765	10.882387	28
33	9.118567	1587	9.996219	28	9.122348	1615	10.877652	10.003781	10.881433	27
34	9.119519	1583	9.996202	28	9.123317	1611	10.876683	10.003798	10.880481	26
35	9.120469	1580	9.996185	28	9.124284	1608	10.875716	10.003815	10.879531	25
36	9.121417	1576	9.996168	28	9.125249	1604	10.874751	10.003832	10.878583	24
37	9.122362	1573	9.996151	28	9.126211	1601	10.873789	10.003849	10.877638	23
38	9.123306	1569	9.996134	28	9.127172	1597	10.872828	10.003866	10.876694	22
39	9.124248	1566	9.996117	28	9.128130	1594	10.871870	10.003883	10.875752	21
40	9.125187	1562	9.996100	28	9.129087	1591	10.870913	10.003900	10.874813	20
41	9.126125	1559	9.996083	28	9.130041	1587	10.869959	10.003917	10.873875	19
42	9.127060	1556	9.996066	28	9.130994	1584	10.869006	10.003934	10.872940	18
43	9.127993	1552	9.996049	28	9.131944	1581	10.868056	10.003951	10.872007	17
44	9.128925	1549	9.996032	28	9.132893	1577	10.867107	10.003968	10.871075	16
45	9.129854	1545	9.996015	28	9.133839	1574	10.866161	10.003985	10.870146	15
46	9.130781	1542	9.995998	30	9.134784	1571	10.865216	10.004002	10.869219	14
47	9.131706	1539	9.995980	28	9.135726	1567	10.864274	10.004020	10.868294	13
48	9.132630	1535	9.995963	28	9.136667	1564	10.863333	10.004037	10.867370	12
49	9.133551	1532	9.995946	30	9.137605	1561	10.862395	10.004054	10.866449	11
50	9.134470	1529	9.995928	28	9.138542	1558	10.861458	10.004072	10.865530	10
51	9.135387	1525	9.995911	28	9.139476	1555	10.860524	10.004089	10.864613	9
52	9.136303	1522	9.995894	30	9.140409	1551	10.859591	10.004106	10.863697	8
53	9.137216	1519	9.995876	28	9.141340	1548	10.858660	10.004124	10.862784	7
54	9.138128	1516	9.995859	30	9.142269	1545	10.857731	10.004141	10.861872	6
55	9.139037	1512	9.995841	30	9.143196	1542	10.856804	10.004159	10.860963	5
56	9.139944	1509	9.995823	28	9.144121	1539	10.855879	10.004177	10.860056	4
57	9.140850	1506	9.995806	30	9.145044	1535	10.854956	10.004194	10.859150	3
58	9.141754	1503	9.995788	28	9.145966	1532	10.854034	10.004212	10.858246	2
59	9.142655	1500	9.995771	30	9.146885	1529	10.853115	10.004229	10.857345	1
60	9.143555		9.995753		9.147803		10.852197	10.004247	10.856445	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

82 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

8 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.143555	1496	9.995753	30	9.147803	1526	10.852197	10.004247	10.856445	60
1	9.144453	1493	9.995735	30	9.148718	1523	10.851282	10.004265	10.855547	59
2	9.145349	1490	9.995717	30	9.149632	1520	10.850368	10.004283	10.854651	58
3	9.146243	1487	9.995699	30	9.150544	1517	10.849456	10.004301	10.853757	57
4	9.147136	1484	9.995681	28	9.151454	1514	10.848546	10.004319	10.852864	56
5	9.148026	1481	9.995664	30	9.152363	1511	10.847637	10.004336	10.851974	55
6	9.148915	1478	9.995646	30	9.153269	1508	10.846731	10.004354	10.851085	54
7	9.149802	1475	9.995628	30	9.154174	1505	10.845826	10.004372	10.850198	53
8	9.150686	1472	9.995610	32	9.155077	1502	10.844923	10.004390	10.849314	52
9	9.151569	1469	9.995591	30	9.155978	1499	10.844022	10.004409	10.848431	51
10	9.152451	1466	9.995573	30	9.156877	1496	10.843123	10.004427	10.847549	50
11	9.153330	1462	9.995555	30	9.157775	1493	10.842225	10.004445	10.846670	49
12	9.154208	1460	9.995537	30	9.158671	1490	10.841329	10.004463	10.845792	48
13	9.155083	1457	9.995519	30	9.159565	1487	10.840435	10.004481	10.844917	47
14	9.155957	1454	9.995501	32	9.160457	1484	10.839543	10.004499	10.844043	46
15	9.156830	1451	9.995482	30	9.161347	1481	10.838653	10.004518	10.843170	45
16	9.157700	1448	9.995464	30	9.162236	1478	10.837764	10.004536	10.842300	44
17	9.158569	1445	9.995446	32	9.163123	1475	10.836877	10.004554	10.841431	43
18	9.159435	1442	9.995427	30	9.164008	1473	10.835992	10.004573	10.840565	42
19	9.160301	1439	9.995409	32	9.164892	1470	10.835108	10.004591	10.839699	41
20	9.161164	1436	9.995390	30	9.165774	1467	10.834226	10.004610	10.838836	40
21	9.162025	1433	9.995372	32	9.166654	1464	10.833346	10.004628	10.837975	39
22	9.162885	1430	9.995353	32	9.167532	1461	10.832468	10.004647	10.837115	38
23	9.163743	1427	9.995334	30	9.168409	1458	10.831591	10.004666	10.836257	37
24	9.164600	1424	9.995316	32	9.169284	1455	10.830716	10.004684	10.835400	36
25	9.165454	1422	9.995297	32	9.170157	1453	10.829843	10.004703	10.834546	35
26	9.166307	1419	9.995278	30	9.171029	1450	10.828971	10.004722	10.833693	34
27	9.167159	1416	9.995260	32	9.171899	1447	10.828101	10.004740	10.832841	33
28	9.168008	1413	9.995241	32	9.172767	1444	10.827233	10.004759	10.831992	32
29	9.168856	1410	9.995222	32	9.173634	1442	10.826366	10.004778	10.831144	31
30	9.169702	1407	9.995203	32	9.174499	1439	10.825501	10.004797	10.830298	30
31	9.170547	1405	9.995184	32	9.175362	1436	10.824638	10.004816	10.829453	29
32	9.171389	1402	9.995165	32	9.176224	1433	10.823776	10.004835	10.828611	28
33	9.172230	1399	9.995146	32	9.177084	1431	10.822916	10.004854	10.827770	27
34	9.173070	1396	9.995127	32	9.177942	1428	10.822058	10.004873	10.826930	26
35	9.173908	1394	9.995108	32	9.178799	1425	10.821201	10.004892	10.826092	25
36	9.174744	1391	9.995089	32	9.179655	1423	10.820345	10.004911	10.825256	24
37	9.175578	1388	9.995070	32	9.180508	1420	10.819492	10.004930	10.824422	23
38	9.176411	1385	9.995051	32	9.181360	1417	10.818640	10.004949	10.823589	22
39	9.177242	1383	9.995032	32	9.182211	1415	10.817789	10.004968	10.822758	21
40	9.178072	1380	9.995013	33	9.183059	1412	10.816941	10.004987	10.821928	20
41	9.178900	1377	9.994993	32	9.183907	1409	10.816093	10.005007	10.821100	19
42	9.179726	1374	9.994974	32	9.184752	1407	10.815248	10.005026	10.820274	18
43	9.180551	1372	9.994955	33	9.185597	1404	10.814403	10.005045	10.819449	17
44	9.181374	1369	9.994935	32	9.186439	1402	10.813561	10.005065	10.818626	16
45	9.182196	1367	9.994916	33	9.187280	1399	10.812720	10.005084	10.817804	15
46	9.183016	1364	9.994896	32	9.188120	1396	10.811880	10.005104	10.816984	14
47	9.183834	1361	9.994877	33	9.188958	1394	10.811042	10.005123	10.816166	13
48	9.184651	1359	9.994857	32	9.189794	1391	10.810206	10.005143	10.815349	12
49	9.185466	1356	9.994838	33	9.190629	1389	10.809371	10.005162	10.814534	11
50	9.186280	1353	9.994818	33	9.191462	1386	10.808538	10.005182	10.813720	10
51	9.187092	1351	9.994798	32	9.192294	1384	10.807706	10.005202	10.812908	9
52	9.187903	1348	9.994779	33	9.193124	1381	10.806876	10.005221	10.812097	8
53	9.188712	1346	9.994759	33	9.193953	1379	10.806047	10.005241	10.811288	7
54	9.189519	1343	9.994739	32	9.194780	1376	10.805220	10.005261	10.810481	6
55	9.190325	1341	9.994720	33	9.195606	1374	10.804394	10.005281	10.809675	5
56	9.191130	1338	9.994700	33	9.196430	1371	10.803570	10.005300	10.808870	4
57	9.191933	1336	9.994680	33	9.197253	1369	10.802747	10.005320	10.808067	3
58	9.192734	1333	9.994660	33	9.198074	1366	10.801926	10.005340	10.807266	2
59	9.193534	1330	9.994640	33	9.198894	1364	10.801106	10.005360	10.806466	1
60	9.194332		9.994620		9.199713		10.800287	10.005380	10.805668	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

81 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

9 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.194332	1328	9.994620	33	9.199713	1361	10.800287	10.005380	10.805668	60
1	9.195129	1326	9.994600	33	9.200529	1359	10.799471	10.005400	10.804871	59
2	9.195925	1323	9.994580	33	9.201345	1356	10.798655	10.005420	10.804075	58
3	9.196719	1321	9.994560	33	9.202159	1354	10.797841	10.005440	10.803281	57
4	9.197511	1318	9.994540	35	9.202971	1352	10.797029	10.005460	10.802489	56
5	9.198302	1316	9.994519	33	9.203782	1349	10.796218	10.005481	10.801698	55
6	9.199091	1313	9.994499	33	9.204592	1347	10.795408	10.005501	10.800909	54
7	9.199879	1311	9.994479	33	9.205400	1345	10.794600	10.005521	10.800121	53
8	9.200666	1308	9.994459	35	9.206207	1342	10.793793	10.005541	10.799334	52
9	9.201451	1306	9.994438	33	9.207013	1340	10.792987	10.005562	10.798549	51
10	9.202234	1304	9.994418	33	9.207817	1338	10.792183	10.005582	10.797766	50
11	9.203017	1301	9.994398	35	9.208619	1335	10.791381	10.005602	10.796983	49
12	9.203797	1299	9.994377	33	9.209420	1333	10.790580	10.005623	10.796203	48
13	9.204577	1296	9.994357	35	9.210220	1331	10.789780	10.005643	10.795423	47
14	9.205354	1294	9.994336	33	9.211018	1328	10.788982	10.005664	10.794646	46
15	9.206131	1292	9.994316	35	9.211815	1326	10.788185	10.005684	10.793869	45
16	9.206906	1289	9.994295	35	9.212611	1324	10.787389	10.005705	10.793094	44
17	9.207679	1287	9.994274	33	9.213405	1321	10.786595	10.005726	10.792321	43
18	9.208452	1285	9.994254	35	9.214198	1319	10.785802	10.005746	10.791548	42
19	9.209222	1282	9.994233	35	9.214989	1317	10.785011	10.005767	10.790778	41
20	9.209992	1280	9.994212	35	9.215780	1315	10.784220	10.005788	10.790008	40
21	9.210760	1278	9.994191	33	9.216568	1312	10.783432	10.005809	10.789240	39
22	9.211526	1275	9.994171	35	9.217356	1310	10.782644	10.005829	10.788474	38
23	9.212291	1273	9.994150	35	9.218142	1308	10.781858	10.005850	10.787709	37
24	9.213055	1271	9.994129	35	9.218926	1305	10.781074	10.005871	10.786945	36
25	9.213818	1268	9.994108	35	9.219710	1303	10.780290	10.005892	10.786182	35
26	9.214579	1266	9.994087	35	9.220492	1301	10.779508	10.005913	10.785421	34
27	9.215338	1264	9.994066	35	9.221272	1299	10.778728	10.005934	10.784662	33
28	9.216097	1261	9.994045	35	9.222052	1297	10.777948	10.005955	10.783903	32
29	9.216854	1259	9.994024	35	9.222830	1294	10.777170	10.005976	10.783146	31
30	9.217609	1257	9.994003	35	9.223607	1292	10.776393	10.005997	10.782391	30
31	9.218363	1255	9.993982	37	9.224382	1290	10.775618	10.006018	10.781637	29
32	9.219116	1253	9.993960	35	9.225156	1288	10.774844	10.006040	10.780884	28
33	9.219868	1250	9.993939	35	9.225929	1286	10.774071	10.006061	10.780132	27
34	9.220618	1248	9.993918	35	9.226700	1284	10.773300	10.006082	10.779382	26
35	9.221367	1246	9.993897	37	9.227471	1281	10.772529	10.006103	10.778633	25
36	9.222115	1244	9.993875	35	9.228239	1279	10.771761	10.006125	10.777885	24
37	9.222861	1242	9.993854	37	9.229007	1277	10.770993	10.006146	10.777139	23
38	9.223606	1239	9.993832	35	9.229773	1275	10.770227	10.006168	10.776394	22
39	9.224349	1237	9.993811	37	9.230539	1273	10.769461	10.006189	10.775651	21
40	9.225092	1235	9.993789	35	9.231302	1271	10.768698	10.006211	10.774908	20
41	9.225833	1233	9.993768	37	9.232065	1269	10.767935	10.006232	10.774167	19
42	9.226573	1231	9.993746	35	9.232826	1267	10.767174	10.006254	10.773427	18
43	9.227311	1228	9.993725	37	9.233586	1265	10.766414	10.006275	10.772689	17
44	9.228048	1226	9.993703	37	9.234345	1262	10.765655	10.006297	10.771952	16
45	9.228784	1224	9.993681	35	9.235103	1260	10.764897	10.006319	10.771216	15
46	9.229518	1222	9.993660	37	9.235859	1258	10 764141	10.006340	10.770482	14
47	9.230252	1220	9.993638	37	9.236614	1256	10.763386	10.006362	10.769748	13
48	9.230984	1218	9.993616	37	9.237368	1254	10.762632	10.006384	10.769016	12
49	9.231715	1216	9.993594	37	9.238120	1252	10.761880	10.006406	10.768285	11
50	9.232444	1214	9.993572	37	9.238872	1250	10.761128	10.006428	10.767556	10
51	9.233172	1212	9.993550	37	9.239622	1248	10.760378	10.006450	10.766828	9
52	9.233899	1209	9.993528	37	9.240371	1246	10.759629	10.006472	10.766101	8
53	9.234625	1207	9.993506	37	9.241118	1244	10.758882	10.006494	10.765375	7
54	9.235349	1205	9.993484	37	9.241865	1242	10.758135	10.006516	10.764651	6
55	9.236073	1203	9.993462	37	9.242610	1240	10.757390	10.006538	10.763927	5
56	9.236795	1201	9.993440	37	9.243354	1238	10.756646	10.006560	10.763205	4
57	9.237515	1199	9.993418	37	9.244097	1236	10.755903	10.006582	10.762485	3
58	9.238235	1197	9.993396	37	9.244839	1234	10.755161	10.006604	10.761765	2
59	9.238953	1195	9.993374	38	9.245579	1232	10.754421	10.006626	10.761047	1
60	9.239670		9.993351		9.246319		10.753681	10.006649	10.760330	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

80 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

10 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.239670	1193	9.993351	37	9.246319	1230	10.753681	10.006649	10.760330	60
1	9.240386	1191	9.993329	37	9.247057	1228	10.752943	10.006671	10.759614	59
2	9.241101	1189	9.993307	38	9.247794	1226	10.752206	10.006693	10.758899	58
3	9.241814	1187	9.993285	37	9.248530	1224	10.751470	10.006715	10.758186	57
4	9.242526	1185	9.993262	37	9.249264	1222	10.750736	10.006738	10.757474	56
5	9.243237	1183	9.993240	38	9.249998	1220	10.750002	10.006760	10.756763	55
6	9.243947	1181	9.993217	37	9.250730	1218	10.749270	10.006783	10.756053	54
7	9.244656	1179	9.993195	38	9.251461	1217	10.748539	10.006805	10.755344	53
8	9.245363	1177	9.993172	38	9.252191	1215	10.747809	10.006828	10.754637	52
9	9.246069	1175	9.993149	37	9.252920	1213	10.747080	10.006851	10.753931	51
10	9.246775	1173	9.993127	38	9.253648	1211	10.746352	10.006873	10.753225	50
11	9.247478	1171	9.993104	38	9.254374	1209	10.745626	10.006896	10.752522	49
12	9.248181	1169	9.993081	37	9.255100	1207	10.744900	10.006919	10.751819	48
13	9.248883	1167	9.993059	38	9.255824	1205	10.744176	10.006941	10.751117	47
14	9.249583	1165	9.993036	38	9.256547	1203	10.743453	10.006964	10.750417	46
15	9.250282	1163	9.993013	38	9.257269	1201	10.742731	10.006987	10.749718	45
16	9.250980	1161	9.992990	38	9.257990	1200	10.742010	10.007010	10.749020	44
17	9.251677	1159	9.992967	38	9.258710	1198	10.741290	10.007033	10.748323	43
18	9.252373	1158	9.992944	38	9.259429	1196	10.740571	10.007056	10.747627	42
19	9.253067	1156	9.992921	38	9.260146	1194	10.739854	10.007079	10.746933	41
20	9.253761	1154	9.992898	38	9.260863	1192	10.739137	10.007102	10.746239	40
21	9.254453	1152	9.992875	38	9.261578	1190	10.738422	10.007125	10.745547	39
22	9.255144	1150	9.992852	38	9.262292	1189	10.737708	10.007148	10.744856	38
23	9.255834	1148	9.992829	38	9.263005	1187	10.736995	10.007171	10.744166	37
24	9.256523	1146	9.992806	38	9.263717	1185	10.736283	10.007194	10.743477	36
25	9.257211	1144	9.992783	40	9.264428	1183	10.735572	10.007217	10.742789	35
26	9.257898	1142	9.992759	38	9.265138	1181	10.734862	10.007241	10.742102	34
27	9.258583	1141	9.992736	38	9.265847	1179	10.734153	10.007264	10.741417	33
28	9.259268	1139	9.992713	38	9.266555	1178	10.733445	10.007287	10.740732	32
29	9.259951	1137	9.992690	40	9.267261	1176	10.732739	10.007311	10.740049	31
30	9.260633	1135	9.992666	38	9.267967	1174	10.732033	10.007334	10.739367	30
31	9.261314	1133	9.992643	40	9.268671	1172	10.731329	10.007357	10.738686	29
32	9.261994	1131	9.992619	38	9.269375	1170	10.730625	10.007381	10.738006	28
33	9.262673	1130	9.992596	40	9.270077	1169	10.729923	10.007404	10.737327	27
34	9.263351	1128	9.992572	38	9.270779	1167	10.729221	10.007428	10.736649	26
35	9.264027	1126	9.992549	40	9.271479	1165	10.728521	10.007451	10.735973	25
36	9.264703	1124	9.992525	40	9.272178	1164	10.727822	10.007475	10.735297	24
37	9.265377	1122	9.992501	38	9.272876	1162	10.727124	10.007499	10.734623	23
38	9.266051	1120	9.992478	40	9.273573	1160	10.726427	10.007522	10.733949	22
39	9.266723	1119	9.992454	40	9.274269	1158	10.725731	10.007546	10.733277	21
40	9.267395	1117	9.992430	40	9.274964	1157	10.725036	10.007570	10.732605	20
41	9.268065	1115	9.992406	40	9.275658	1155	10.724342	10.007594	10.731935	19
42	9.268734	1113	9.992382	38	9.276351	1153	10.723649	10.007618	10.731266	18
43	9.269402	1111	9.992358	40	9.277043	1151	10.722957	10.007642	10.730598	17
44	9.270069	1110	9.992335	40	9.277734	1150	10.722266	10.007665	10.729931	16
45	9.270735	1108	9.992311	40	9.278424	1148	10.721576	10.007689	10.729265	15
46	9.271400	1106	9.992287	40	9.279113	1146	10.720887	10.007713	10.728600	14
47	9.272064	1105	9.992263	40	9.279801	1145	10.720199	10.007737	10.727936	13
48	9.272726	1103	9.992239	42	9.280488	1143	10.719512	10.007761	10.727274	12
49	9.273388	1101	9.992214	40	9.281174	1141	10.718826	10.007786	10.726612	11
50	9.274049	1099	9.992190	40	9.281858	1140	10.718142	10.007810	10.725951	10
51	9.274708	1098	9.992166	40	9.282542	1138	10.717458	10.007834	10.725292	9
52	9.275367	1096	9.992142	40	9.283225	1136	10.716775	10.007858	10.724633	8
53	9.276025	1094	9.992118	42	9.283907	1135	10.716093	10.007882	10.723975	7
54	9.276681	1092	9.992093	40	9.284588	1133	10.715412	10.007907	10.723319	6
55	9.277337	1091	9.992069	42	9.285268	1131	10.714732	10.007931	10.722663	5
56	9.277991	1089	9.992044	40	9.285947	1130	10.714053	10.007956	10.722009	4
57	9.278645	1087	9.992020	40	9.286624	1128	10.713376	10.007980	10.721355	3
58	9.279297	1086	9.991996	42	9.287301	1126	10.712699	10.008004	10.720703	2
59	9.279948	1084	9.991971	40	9.287977	1125	10.712023	10.008029	10.720052	1
60	9.280599		9.991947		9.288652		10.711348	10.008053	10.719401	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

79 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

11 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.280599	1082	9.991947	42	9.288652	1123	10.711348	10.008053	10.719401	60
1	9.281248	1081	9.991922	42	9.289326	1122	10.710674	10.008078	10.718752	59
2	9.281897	1079	9.991897	40	9.289999	1120	10.710001	10.008103	10.718103	58
3	9.282544	1077	9.991873	42	9.290671	1118	10.709329	10.008127	10.717456	57
4	9.283190	1076	9.991848	42	9.291342	1117	10.708658	10.008152	10.716810	56
5	9.283836	1074	9.991823	40	9.292013	1115	10.707987	10.008177	10.716164	55
6	9.284480	1072	9.991799	42	9.292682	1114	10.707318	10.008201	10.715520	54
7	9.285124	1071	9.991774	42	9.293350	1112	10.706650	10.008226	10.714876	53
8	9.285766	1069	9.991749	42	9.294017	1111	10.705983	10.008251	10.714234	52
9	9.286408	1067	9.991724	42	9.294684	1109	10.705316	10.008276	10.713592	51
10	9.287048	1066	9.991699	42	9.295349	1107	10.704651	10.008301	10.712952	50
11	9.287688	1064	9.991674	42	9.296013	1106	10.703987	10.008326	10.712312	49
12	9.288326	1063	9.991649	42	9.296677	1104	10.703323	10.008351	10.711674	48
13	9.288964	1061	9.991624	42	9.297339	1103	10.702661	10.008376	10.711036	47
14	9.289600	1059	9.991599	42	9.298001	1101	10.701999	10.008401	10.710400	46
15	9.290236	1058	9.991574	42	9.298662	1100	10.701338	10.008426	10.709764	45
16	9.290870	1056	9.991549	42	9.299322	1098	10.700678	10.008451	10.709130	44
17	9.291504	1054	9.991524	43	9.299980	1096	10.700020	10.008476	10.708496	43
18	9.292137	1053	9.991498	42	9.300638	1095	10.699362	10.008502	10.707863	42
19	9.292768	1051	9.991473	42	9.301295	1093	10.698705	10.008527	10.707232	41
20	9.293399	1050	9.991448	43	9.301951	1092	10.698049	10.008552	10.706601	40
21	9.294029	1048	9.991422	42	9.302607	1090	10.697393	10.008578	10.705971	39
22	9.294658	1046	9.991397	42	9.303261	1089	10.696739	10.008603	10.705342	38
23	9.295286	1045	9.991372	43	9.303914	1087	10.696086	10.008628	10.704714	37
24	9.295913	1043	9.991346	42	9.304567	1086	10.695433	10.008654	10.704087	36
25	9.296539	1042	9.991321	43	9.305218	1084	10.694782	10.008679	10.703461	35
26	9.297164	1040	9.991295	42	9.305869	1083	10.694131	10.008705	10.702836	34
27	9.297788	1039	9.991270	43	9.306519	1081	10.693481	10.008730	10.702212	33
28	9.298412	1037	9.991244	43	9.307168	1080	10.692832	10.008756	10.701588	32
29	9.299034	1036	9.991218	42	9.307815	1078	10.692185	10.008782	10.700966	31
30	9.299655	1034	9.991193	43	9.308463	1077	10.691537	10.008807	10.700345	30
31	9.300276	1032	9.991167	43	9.309109	1075	10.690891	10.008833	10.699724	29
32	9.300895	1031	9.991141	43	9.309754	1074	10.690246	10.008859	10.699105	28
33	9.301514	1029	9.991115	42	9.310398	1073	10.689602	10.008885	10.698486	27
34	9.302132	1028	9.991090	43	9.311042	1071	10.688958	10.008910	10.697868	26
35	9.302748	1027	9.991064	43	9.311685	1070	10.688315	10.008936	10.697252	25
36	9.303364	1025	9.991038	43	9.312327	1068	10.687673	10.008962	10.696636	24
37	9.303979	1023	9.991012	43	9.312967	1067	10.687033	10.008988	10.696021	23
38	9.304593	1022	9.990986	43	9.313608	1065	10.686392	10.009014	10.695407	22
39	9.305207	1020	9.990960	43	9.314247	1064	10.685753	10.009040	10.694793	21
40	9.305819	1019	9.990934	43	9.314885	1062	10.685115	10.009066	10.694181	20
41	9.306430	1017	9.990908	43	9.315523	1061	10.684477	10.009092	10.693570	19
42	9.307041	1016	9.990882	45	9.316159	1060	10.683841	10.009118	10.692959	18
43	9.307650	1014	9.990855	43	9.316795	1058	10.683205	10.009145	10.692350	17
44	9.308259	1013	9.990829	43	9.317430	1057	10.682570	10.009171	10.691741	16
45	9.308867	1011	9.990803	43	9.318064	1055	10.681936	10.009197	10.691133	15
46	9.309474	1010	9.990777	45	9.318697	1054	10.681303	10.009223	10.690526	14
47	9.310080	1008	9.990750	43	9.319329	1053	10.680671	10.009250	10.689920	13
48	9.310685	1007	9.990724	45	9.319961	1051	10.680039	10.009276	10.689315	12
49	9.311289	1006	9.990697	43	9.320592	1050	10.679408	10.009303	10.688711	11
50	9.311893	1004	9.990671	43	9.321222	1048	10.678778	10.009329	10.688107	10
51	9.312495	1003	9.990645	45	9.321851	1047	10.678149	10.009355	10.687505	9
52	9.313097	1001	9.990618	45	9.322479	1045	10.677521	10.009382	10.686903	8
53	9.313698	1000	9.990591	43	9.323106	1044	10.676894	10.009409	10.686302	7
54	9.314297	998	9.990565	45	9.323733	1043	10.676267	10.009435	10.685703	6
55	9.314897	997	9.990538	45	9.324358	1041	10.675642	10.009462	10.685103	5
56	9.315495	996	9.990511	43	9.324983	1040	10.675017	10.009489	10.684505	4
57	9.316092	994	9.990485	45	9.325607	1039	10.674393	10.009515	10.683908	3
58	9.316689	993	9.990458	45	9.326231	1037	10.673769	10.009542	10.683311	2
59	9.317284	991	9.990431	45	9.326853	1036	10.673147	10.009569	10.682716	1
60	9.317879		9.990404		9.327475		10.672525	10.009596	10.682121	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

78 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

12 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.317879	990	9.990404	43	9.327474	1035	10.672526	10.009596	10.682121	60
1	9.318473	988	9.990378	45	9.328095	1033	10.671905	10.009622	10.681527	59
2	9.319066	987	9.990351	45	9.328715	1032	10.671285	10.009649	10.680934	58
3	9.319658	986	9.990324	45	9.329334	1030	10.670666	10.009676	10.680342	57
4	9.320249	984	9.990297	45	9.329953	1029	10.670047	10.009703	10.679751	56
5	9.320840	983	9.990270	45	9.330570	1028	10.669430	10.009730	10.679160	55
6	9.321430	982	9.990243	47	9.331187	1026	10.668813	10.009757	10.678570	54
7	9.322019	980	9.990215	45	9.331803	1025	10.668197	10.009785	10.677981	53
8	9.322607	979	9.990188	45	9.332418	1024	10.667582	10.009812	10.677393	52
9	9.323194	977	9.990161	45	9.333033	1023	10.666967	10.009839	10.676806	51
10	9.323780	976	9.990134	45	9.333646	1021	10.666354	10.009866	10.676220	50
11	9.324366	975	9.990107	47	9.334259	1020	10.665741	10.009893	10.675634	49
12	9.324950	973	9.990079	45	9.334871	1019	10.665129	10.009921	10.675050	48
13	9.325534	972	9.990052	45	9.335482	1017	10.664518	10.009948	10.674466	47
14	9.326117	970	9.990025	47	9.336093	1016	10.663907	10.009975	10.673883	46
15	9.326700	969	9.989997	45	9.336702	1015	10.663298	10.010003	10.673300	45
16	9.327281	968	9.989970	47	9.337311	1013	10.662689	10.010030	10.672719	44
17	9.327862	966	9.989942	45	9.337919	1012	10.662081	10.010058	10.672138	43
18	9.328442	965	9.989915	47	9.338527	1011	10.661473	10.010085	10.671558	42
19	9.329021	964	9.989887	45	9.339133	1010	10.660867	10.010113	10.670979	41
20	9.329599	962	9.989860	47	9.339739	1008	10.660261	10.010140	10.670401	40
21	9.330176	961	9.989832	47	9.340344	1007	10.659656	10.010168	10.669824	39
22	9.330753	960	9.989804	45	9.340948	1006	10.659052	10.010196	10.669247	38
23	9.331329	958	9.989777	47	9.341552	1004	10.658448	10.010223	10.668671	37
24	9.331903	957	9.989749	47	9.342155	1003	10.657845	10.010251	10.668097	36
25	9.332478	956	9.989721	47	9.342757	1002	10.657243	10.010279	10.667522	35
26	9.333051	954	9.989693	47	9.343358	1001	10.656642	10.010307	10.666949	34
27	9.333624	953	9.989665	47	9.343958	999	10.656042	10.010335	10.666376	33
28	9.334195	952	9.989637	45	9.344558	998	10.655442	10.010363	10.665805	32
29	9.334767	950	9.989610	47	9.345157	997	10.654843	10.010390	10.665233	31
30	9.335337	949	9.989582	48	9.345755	996	10.654245	10.010418	10.664663	30
31	9.335906	948	9.989553	47	9.346353	994	10.653647	10.010447	10.664094	29
32	9.336475	946	9.989525	47	9.346949	993	10.653051	10.010475	10.663525	28
33	9.337043	945	9.989497	47	9.347545	992	10.652455	10.010503	10.662957	27
34	9.337610	944	9.989469	47	9.348141	991	10.651859	10.010531	10.662390	26
35	9.338176	943	9.989441	47	9.348735	990	10.651265	10.010559	10.661824	25
36	9.338742	941	9.989413	47	9.349329	988	10.650671	10.010587	10.661258	24
37	9.339307	940	9.989385	48	9.349922	987	10.650078	10.010615	10.660693	23
38	9.339871	939	9.989356	47	9.350514	986	10.649486	10.010644	10.660129	22
39	9.340434	937	9.989328	47	9.351106	985	10.648894	10.010672	10.659566	21
40	9.340996	936	9.989300	48	9.351697	983	10.648303	10.010700	10.659004	20
41	9.341558	935	9.989271	47	9.352287	982	10.647713	10.010729	10.658442	19
42	9.342119	934	9.989243	48	9.352876	981	10.647124	10.010757	10.657881	18
43	9.342679	932	9.989214	47	9.353465	980	10.646535	10.010786	10.657321	17
44	9.343239	931	9.989186	48	9.354053	979	10.645947	10.010814	10.656761	16
45	9.343797	930	9.989157	48	9.354640	977	10.645360	10.010843	10.656203	15
46	9.344355	929	9.989128	47	9.355227	976	10.644773	10.010872	10.655645	14
47	9.344912	927	9.989100	48	9.355813	975	10.644187	10.010900	10.655088	13
48	9.345469	926	9.989071	48	9.356398	974	10.643602	10.010929	10.654531	12
49	9.346024	925	9.989042	47	9.356982	973	10.643018	10.010958	10.653976	11
50	9.346579	924	9.989014	48	9.357566	971	10.642434	10.010986	10.653421	10
51	9.347134	922	9.988985	48	9.358149	970	10.641851	10.011015	10.652866	9
52	9.347687	921	9.988956	48	9.358731	969	10.641269	10.011044	10.652313	8
53	9.348240	920	9.988927	48	9.359313	968	10.640687	10.011073	10.651760	7
54	9.348792	919	9.988898	48	9.359893	967	10.640107	10.011102	10.651208	6
55	9.349343	917	9.988869	48	9.360474	966	10.639526	10.011131	10.650657	5
56	9.349893	916	9.988840	48	9.361053	965	10.638947	10.011160	10.650107	4
57	9.350443	915	9.988811	48	9.361632	963	10.638368	10.011189	10.649557	3
58	9.350992	914	9.988782	48	9.362210	962	10.637790	10.011218	10.649008	2
59	9.351540	913	9.988753	48	9.362787	961	10.637213	10.011247	10.648460	1
60	9.352088		9.988724		9.363364		10.636636	10.011276	10.647912	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co sec.	Secant.	M

77 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

13 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.352088	911	9.988724	48	9.363364	960	10.636636	10.011276	10.647912	60
1	9.352635	910	9.988695	48	9.363940	959	10.636060	10.011305	10.647365	59
2	9.353181	909	9.988666	50	9.364515	958	10.635485	10.011334	10.646819	58
3	9.353726	908	9.988636	48	9.365090	957	10.634910	10.011364	10.646274	57
4	9.354271	907	9.988607	48	9.365664	955	10.634336	10.011393	10.645729	56
5	9.354815	905	9.988578	50	9.366237	954	10.633763	10.011422	10.645185	55
6	9.355358	904	9.988548	48	9.366810	953	10.633190	10.011452	10.644642	54
7	9.355901	903	9.988519	50	9.367382	952	10.632618	10.011481	10.644099	53
8	9.356443	902	9.988489	48	9.367953	951	10.632047	10.011511	10.643557	52
9	9.356984	901	9.988460	50	9.368524	950	10.631476	10.011540	10.643016	51
10	9.357524	899	9.988430	48	9.369094	949	10.630906	10.011570	10.642476	50
11	9.358064	898	9.988401	50	9.369663	948	10.630337	10.011599	10.641936	49
12	9.358603	897	9.988371	48	9.370232	946	10.629768	10.011629	10.641397	48
13	9.359141	896	9.988342	50	9.370799	945	10.629201	10.011658	10.640859	47
14	9.359678	895	9.988312	50	9.371367	944	10.628633	10.011688	10.640322	46
15	9.360215	893	9.988282	50	9.371933	943	10.628067	10.011718	10.639785	45
16	9.360752	892	9.988252	48	9.372499	942	10.627501	10.011748	10.639248	44
17	9.361287	891	9.988223	50	9.373064	941	10.626936	10.011777	10.638713	43
18	9.361822	890	9.988193	50	9.373629	940	10.626371	10.011807	10.638178	42
19	9.362356	889	9.988163	50	9.374193	939	10.625807	10.011837	10.637644	41
20	9.362889	888	9.988133	50	9.374756	938	10.625244	10.011867	10.637111	40
21	9.363422	887	9.988103	50	9.375319	937	10.624681	10.011897	10.636578	39
22	9.363954	885	9.988073	50	9.375881	935	10.624119	10.011927	10.636046	38
23	9.364485	884	9.988043	50	9.376442	934	10.623558	10.011957	10.635515	37
24	9.365016	883	9.988013	50	9.377003	933	10.622997	10.011987	10.634984	36
25	9.365546	882	9.987983	50	9.377563	932	10.622437	10.012017	10.634454	35
26	9.366075	881	9.987953	52	9.378122	931	10.621878	10.012047	10.633925	34
27	9.366604	880	9.987922	50	9.378681	930	10.621319	10.012078	10.633396	33
28	9.367131	879	9.987892	50	9.379239	929	10.620761	10.012108	10.632869	32
29	9.367659	878	9.987862	50	9.379797	928	10.620203	10.012138	10.632341	31
30	9.368185	876	9.987832	52	9.380354	927	10.619646	10.012168	10.631815	30
31	9.368711	875	9.987801	50	9.380910	926	10.619090	10.012199	10.631289	29
32	9.369236	874	9.987771	52	9.381466	925	10.618534	10.012229	10.630764	28
33	9.369761	873	9.987740	50	9.382020	924	10.617980	10.012260	10.630239	27
34	9.370285	872	9.987710	52	9.382575	923	10.617425	10.012290	10.629715	26
35	9.370808	871	9.987679	50	9.383129	922	10.616871	10.012321	10.629192	25
36	9.371330	870	9.987649	52	9.383682	921	10.616318	10.012351	10.628670	24
37	9.371852	869	9.987618	50	9.384234	920	10.615766	10.012382	10.628148	23
38	9.372373	867	9.987588	52	9.384786	919	10.615214	10.012412	10.627627	22
39	9.372894	866	9.987557	52	9.385337	918	10.614663	10.012443	10.627106	21
40	9.373414	865	9.987526	50	9.385888	917	10.614112	10.012474	10.626586	20
41	9.373933	864	9.987496	52	9.386438	916	10.613562	10.012504	10.626067	19
42	9.374452	863	9.987465	52	9.386987	914	10.613013	10.012535	10.625548	18
43	9.374970	862	9.987434	52	9.387536	913	10.612464	10.012566	10.625030	17
44	9.375487	861	9.987403	52	9.388084	912	10.611916	10.012597	10.624513	16
45	9.376003	860	9.987372	52	9.388631	911	10.611369	10.012628	10.623997	15
46	9.376519	859	9.987341	52	9.389178	910	10 610822	10.012659	10.623481	14
47	9.377035	858	9.987310	52	9.389724	909	10.610276	10.012690	10.622965	13
48	9.377549	857	9.987279	52	9.390270	908	10.609730	10.012721	10.622451	12
49	9.378063	856	9.987248	52	9.390815	907	10.609185	10.012752	10.621937	11
50	9.378577	854	9.987217	52	9.391360	906	10.608640	10.012783	10.621423	10
51	9.379089	853	9.987186	52	9.391903	905	10.608097	10.012814	10.620911	9
52	9.379601	852	9.987155	52	9.392447	904	10.607553	10.012845	10.620399	8
53	9.380113	851	9.987124	53	9.392989	903	10.607011	10.012876	10.619887	7
54	9.380624	850	9.987092	52	9.393531	902	10.606469	10.012908	10.619376	6
55	9.381134	849	9.987061	52	9.394073	901	10.605927	10.012939	10.018866	5
56	9.381643	848	9.987030	53	9.394614	900	10.605386	10.012970	10.618357	4
57	9.382152	847	9.986998	52	9.395154	899	10.604846	10.013002	10.617848	3
58	9.382661	846	9.986967	52	9.395694	898	10.604306	10.013033	10.617339	2
59	9.383168	845	9.986936	53	9.396233	897	10.603767	10.013064	10.616832	1
60	9.383675		9.986904		9.396771		10.603229	10.013096	10.616325	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

76 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

14 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.383675	844	9.986904	52	9.396771	896	10.603229	10.013096	10.616325	60
1	9.384182	843	9.986873	53	9.397309	896	10.602691	10.013127	10.615818	59
2	9.384687	842	9.986841	53	9.397846	895	10.602154	10.013159	10.615313	58
3	9.385192	841	9.986809	52	9.398383	894	10.601617	10.013191	10.614808	57
4	9.385697	840	9.986778	53	9.398919	893	10.601081	10.013222	10.614303	56
5	9.386201	839	9.986746	53	9.399455	892	10.600545	10.013254	10.613799	55
6	9.386704	838	9.986714	52	9.399990	891	10.600010	10.013286	10.613296	54
7	9.387207	837	9.986683	53	9.400524	890	10.599476	10.013317	10.612793	53
8	9.387709	836	9.986651	53	9.401058	889	10.598942	10.013349	10.612291	52
9	9.388210	835	9.986619	53	9.401591	888	10.598409	10.013381	10.611790	51
10	9.388711	834	9.986587	53	9.402124	887	10.597876	10.013413	10.611289	50
11	9.389211	833	9.986555	53	9.402656	886	10.597344	10.013445	10.610789	49
12	9.389711	832	9.986523	53	9.403187	885	10.596813	10.013477	10.610289	48
13	9.390210	831	9.986491	53	9.403718	884	10.596282	10.013509	10.609790	47
14	9.390708	830	9.986459	53	9.404249	883	10.595751	10.013541	10.609292	46
15	9.391206	828	9.986427	53	9.404778	882	10.595222	10.013573	10.608794	45
16	9.391703	827	9.986395	53	9.405308	881	10.594692	10.013605	10.608297	44
17	9.392199	826	9.986363	53	9.405836	880	10.594164	10.013637	10.607801	43
18	9.392695	825	9.986331	53	9.406364	879	10.593636	10.013669	10.607305	42
19	9.393191	824	9.986299	55	9.406892	878	10.593108	10.013701	10.606810	41
20	9.393685	823	9.986266	53	9.407419	877	10.592581	10.013734	10.606315	40
21	9.394179	822	9.986234	53	9.407945	876	10.592055	10.013766	10.605821	39
22	9.394673	821	9.986202	55	9.408471	875	10.591529	10.013798	10.605327	38
23	9.395166	820	9.986169	53	9.408997	874	10.591003	10.013831	10.604834	37
24	9.395658	819	9.986137	55	9.409521	874	10.590479	10.013863	10.604342	36
25	9.396150	818	9.986104	53	9.410045	873	10.589955	10.013896	10.603850	35
26	9.396641	817	9.986072	55	9.410569	872	10.589431	10.013928	10.603359	34
27	9.397132	817	9.986039	53	9.411092	871	10.588908	10.013961	10.602868	33
28	9.397621	816	9.986007	55	9.411615	870	10.588385	10.013993	10.602379	32
29	9.398111	815	9.985974	53	9.412137	869	10.587863	10.014026	10.601889	31
30	9.398600	814	9.985942	55	9.412658	868	10.587342	10.014058	10.601400	30
31	9.399088	813	9.985909	55	9.413179	867	10.586821	10.014091	10.600912	29
32	9.399575	812	9.985876	55	9.413699	866	10.586301	10.014124	10.600425	28
33	9.400062	811	9.985843	53	9.414219	865	10.585781	10.014157	10.599938	27
34	9.400549	810	9.985811	55	9.414738	864	10.585262	10.014189	10.599451	26
35	9.401035	809	9.985778	55	9.415257	864	10.584743	10.014222	10.598965	25
36	9.401520	808	9.985745	55	9.415775	863	10.584225	10.014255	10.598480	24
37	9.402005	807	9.985712	55	9.416293	862	10.583707	10.014288	10.597995	23
38	9.402489	806	9.985679	55	9.416810	861	10.583190	10.014321	10.597511	22
39	9.402972	805	9.985646	55	9.417326	860	10.582674	10.014354	10.597028	21
40	9.403455	804	9.985613	55	9.417842	859	10.582158	10.014387	10.596545	20
41	9.403938	803	9.985580	55	9.418358	858	10.581642	10.014420	10.596062	19
42	9.404420	802	9.985547	55	9.418873	857	10.581127	10.014453	10.595580	18
43	9.404901	801	9.985514	57	9.419387	856	10.580613	10.014486	10.595099	17
44	9.405382	800	9.985480	55	9.419901	855	10.580099	10.014520	10.594618	16
45	9.405862	799	9.985447	55	9.420415	855	10.579585	10.014553	10.594138	15
46	9.406341	798	9.985414	55	9.420927	854	10.579073	10.014586	10.593659	14
47	9.406820	797	9.985381	57	9.421440	853	10.578560	10.014619	10.593180	13
48	9.407299	796	9.985347	55	9.421952	852	10.578048	10.014653	10.592701	12
49	9.407777	795	9.985314	57	9.422463	851	10.577537	10.014686	10.592223	11
50	9.408254	794	9.985280	55	9.422974	850	10.577026	10.014720	10.591746	10
51	9.408731	794	9.985247	57	9.423484	849	10.576516	10.014753	10.591269	9
52	9.409207	793	9.985213	55	9.423993	848	10.576007	10.014787	10.590793	8
53	9.409682	792	9.985180	57	9.424503	848	10.575497	10.014820	10.590318	7
54	9.410157	791	9.985146	55	9.425011	847	10.574989	10.014854	10.589843	6
55	9.410632	790	9.985113	57	9.425519	846	10.574481	10.014887	10.589368	5
56	9.411106	789	9.985079	57	9.426027	845	10.573973	10.014921	10.588894	4
57	9.411579	788	9.985045	57	9.426534	844	10.573466	10.014955	10.588421	3
58	9.412052	787	9.985011	55	9.427041	843	10.572959	10.014989	10.587948	2
59	9.412524	786	9.984978	57	9.427547	843	10.572453	10.015022	10.587476	1
60	9.412996		9.984944		9.428052		10.571948	10.015056	10.587004	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

75 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

15 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.412996	785	9.984944	57	9.428052	842	10.571948	10.015056	10.587004	60
1	9.413467	784	9.984910	57	9.428557	841	10.571443	10.015090	10.586533	59
2	9.413938	783	9.984876	57	9.429062	840	10.570938	10.015124	10.586062	58
3	9.414408	783	9.984842	57	9.429566	839	10.570434	10.015158	10.585592	57
4	9.414878	782	9.984808	57	9.430070	838	10.569930	10.015192	10.585122	56
5	9.415347	781	9.984774	57	9.430573	838	10.569427	10.015226	10.584653	55
6	9.415815	780	9.984740	57	9.431075	837	10.568925	10.015260	10.584185	54
7	9.416283	779	9.984706	57	9.431577	836	10.568423	10.015294	10.583717	53
8	9.416751	778	9.984672	57	9.432079	835	10.567921	10.015328	10.583249	52
9	9.417217	777	9.984638	58	9.432580	834	10.567420	10.015362	10.582783	51
10	9.417684	776	9.984603	57	9.433080	833	10.566920	10.015397	10.582316	50
11	9.418150	775	9.984569	57	9.433580	832	10.566420	10.015431	10.581850	49
12	9.418615	774	9.984535	58	9.434080	832	10.565920	10.015465	10.581385	48
13	9.419079	773	9.984500	57	9.434579	831	10.565421	10.015500	10.580921	47
14	9.419544	773	9.984466	57	9.435078	830	10.564922	10.015534	10.580456	46
15	9.420007	772	9.984432	58	9.435576	829	10.564424	10.015568	10.579993	45
16	9.420470	771	9.984397	57	9.436073	828	10.563927	10.015603	10.579530	44
17	9.420933	770	9.984363	58	9.436570	828	10.563430	10.015637	10.579067	43
18	9.421395	769	9.984328	58	9.437067	827	10.562933	10.015672	10.578605	42
19	9.421857	768	9.984294	57	9.437563	826	10.562437	10.015706	10.578143	41
20	9.422318	767	9.984259	58	9.438059	825	10.561941	10.015741	10.577682	40
21	9.422778	767	9.984224	57	9.438554	824	10.561446	10.015776	10.577222	39
22	9.423238	766	9.984190	58	9.439048	823	10.560952	10.015810	10.576762	38
23	9.423697	765	9.984155	58	9.439543	823	10.560457	10.015845	10.576303	37
24	9.424156	764	9.984120	58	9.440036	822	10.559964	10.015880	10.575844	36
25	9.424615	763	9.984085	58	9.440529	821	10.559471	10.015915	10.575385	35
26	9.425073	762	9.984050	58	9.441022	820	10.558978	10.015950	10.574927	34
27	9.425530	761	9.984015	57	9.441514	819	10.558486	10.015985	10.574470	33
28	9.425987	760	9.983981	58	9.442006	819	10.557994	10.016019	10.574013	32
29	9.426443	760	9.983946	58	9.442497	818	10.557503	10.016054	10.573557	31
30	9.426899	759	9.983911	60	9.442988	817	10.557012	10.016089	10.573101	30
31	9.427354	758	9.983875	58	9.443479	816	10.556521	10.016125	10.572646	29
32	9.427809	757	9.983840	58	9.443968	816	10.556032	10.016160	10.572191	28
33	9.428263	756	9.983805	58	9.444458	815	10.555542	10.016195	10.571737	27
34	9.428717	755	9.983770	58	9.444947	814	10.555053	10.016230	10.571283	26
35	9.429170	754	9.983735	58	9.445435	813	10.554565	10.016265	10.570830	25
36	9.429623	753	9.983700	60	9.445923	812	10.554077	10.016300	10.570377	24
37	9.430075	752	9.983664	58	9.446411	812	10.553589	10.016336	10.569925	23
38	9.430527	752	9.983629	58	9.446898	811	10.553102	10.016371	10.569473	22
39	9.430978	751	9.983594	60	9.447384	810	10.552616	10.016406	10.569022	21
40	9.431429	750	9.983558	58	9.447870	809	10.552130	10.016442	10.568571	20
41	9.431879	749	9.983523	60	9.448356	809	10.551644	10.016477	10.568121	19
42	9.432329	749	9.983487	58	9.448841	808	10.551159	10.016513	10.567671	18
43	9.432778	748	9.983452	60	9.449326	807	10.550674	10.016548	10.567222	17
44	9.433226	747	9.983416	58	9.449810	806	10.550190	10.016584	10.566774	16
45	9.433675	746	9.983381	60	9.450294	806	10.549706	10.016619	10.566325	15
46	9.434122	745	9.983345	60	9.450777	805	10.549223	10.016655	10.565878	14
47	9.434569	744	9.983309	60	9.451260	804	10.548740	10.016691	10.565431	13
48	9.435016	744	9.983273	58	9.451743	803	10.548257	10.016727	10.564984	12
49	9.435462	743	9.983238	60	9.452225	802	10.547775	10.016762	10.564538	11
50	9.435908	742	9.983202	60	9.452706	802	10.547294	10.016798	10.564092	10
51	9.436353	741	9.983166	60	9.453187	801	10.546813	10.016834	10.563647	9
52	9.436798	740	9.983130	60	9.453668	800	10.546332	10.016870	10.563202	8
53	9.437242	740	9.983094	60	9.454148	799	10.545852	10.016906	10.562758	7
54	9.437686	739	9.983058	60	9.454628	799	10.545372	10.016942	10.562314	6
55	9.438129	738	9.983022	60	9.455107	798	10.544893	10.016978	10.561871	5
56	9.438572	737	9.982986	60	9.455586	797	10.544414	10.017014	10.561428	4
57	9.439014	736	9.982950	60	9.456064	796	10.543936	10.017050	10.560986	3
58	9.439456	736	9.982914	60	9.456542	796	10.543458	10.017086	10.560544	2
59	9.439897	735	9.982878	60	9.457019	795	10.542981	10.017122	10.560103	1
60	9.440338		9.982842		9.457496		10.542504	10.017158	10.559662	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

74 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

16 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.440338	734	9.982842	62	9.457496	794	10.542504	10.017158	10.559662	60
1	9.440778	733	9.982805	60	9.457973	793	10.542027	10.017195	10.559222	59
2	9.441218	732	9.982769	60	9.458449	793	10.541551	10.017231	10.558782	58
3	9.441658	731	9.982733	62	9.458925	792	10.541075	10.017267	10.558342	57
4	9.442096	731	9.982696	60	9.459400	791	10.540600	10.017304	10.557904	56
5	9.442535	730	9.982660	60	9.459875	790	10.540125	10.017340	10.557465	55
6	9.442973	729	9.982624	62	9.460349	790	10.539651	10.017376	10.557027	54
7	9.443410	728	9.982587	60	9.460823	789	10.539177	10.017413	10.556590	53
8	9.443847	727	9.982551	62	9.461297	788	10.538703	10.017449	10.556153	52
9	9.444284	727	9.982514	62	9.461770	788	10.538230	10.017486	10.555716	51
10	9.444720	726	9.982477	60	9.462242	787	10.537758	10.017523	10.555280	50
11	9.445155	725	9.982441	62	9.462714	786	10.537286	10.017559	10.554845	49
12	9.445590	724	9.982404	62	9.463186	785	10.536814	10.017596	10.554410	48
13	9.446025	723	9.982367	60	9.463658	785	10.536342	10.017633	10.553975	47
14	9.446459	723	9.982331	62	9.464128	784	10.535872	10.017669	10.553541	46
15	9.446893	722	9.982294	62	9.464599	783	10.535401	10.017706	10.553107	45
16	9.447326	721	9.982257	62	9.465069	783	10.534931	10.017743	10.552674	44
17	9.447759	720	9.982220	62	9.465539	782	10.534461	10.017780	10.552241	43
18	9.448191	720	9.982183	62	9.466008	781	10.533992	10.017817	10.551809	42
19	9.448623	719	9.982146	62	9.466476	780	10.533524	10.017854	10.551377	41
20	9.449054	718	9.982109	62	9.466945	780	10.533055	10.017891	10.550946	40
21	9.449485	717	9.982072	62	9.467413	779	10.532587	10.017928	10.550515	39
22	9.449915	716	9.982035	62	9.467880	778	10.532120	10.017965	10.550085	38
23	9.450345	716	9.981998	62	9.468347	778	10.531653	10.018002	10.549655	37
24	9.450775	715	9.981961	62	9.468814	777	10.531186	10.018039	10.549225	36
25	9.451204	714	9.981924	63	9.469280	776	10.530720	10.018076	10.548796	35
26	9.451632	713	9.981886	62	9.469746	775	10.530254	10.018114	10.548368	34
27	9.452060	713	9.981849	62	9.470211	775	10.529789	10.018151	10.547940	33
28	9.452488	712	9.981812	63	9.470676	774	10.529324	10.018188	10.547512	32
29	9.452915	711	9.981774	62	9.471141	773	10.528859	10.018226	10.547085	31
30	9.453342	710	9.981737	62	9.471605	773	10.528395	10.018263	10.546658	30
31	9.453768	710	9.981700	63	9.472068	772	10.527932	10.018300	10.546232	29
32	9.454194	709	9.981662	62	9.472532	771	10.527468	10.018338	10.545806	28
33	9.454619	708	9.981625	63	9.472995	771	10.527005	10.018375	10.545381	27
34	9.455044	707	9.981587	63	9.473457	770	10.526543	10.018413	10.544956	26
35	9.455469	707	9.981549	62	9.473919	769	10.526081	10.018451	10.544531	25
36	9.455893	706	9.981512	63	9.474381	769	10.525619	10.018488	10.544107	24
37	9.456316	705	9.981474	63	9.474842	768	10.525158	10.018526	10.543684	23
38	9.456739	704	9.981436	62	9.475303	767	10.524697	10.018564	10.543261	22
39	9.457162	704	9.981399	63	9.475763	767	10.524237	10.018601	10.542838	21
40	9.457584	703	9.981361	63	9.476223	766	10.523777	10.018639	10.542416	20
41	9.458006	702	9.981323	63	9.476683	765	10.523317	10.018677	10.541994	19
42	9.458427	701	9.981285	63	9.477142	765	10.522858	10.018715	10.541573	18
43	9.458848	701	9.981247	63	9.477601	764	10.522399	10.018753	10.541152	17
44	9.459268	700	9.981209	63	9.478059	763	10.521941	10.018791	10.540732	16
45	9.459688	699	9.981171	63	9.478517	763	10.521483	10.018829	10.540312	15
46	9.460108	698	9.981133	63	9.478975	762	10.521025	10.018867	10.539892	14
47	9.460527	698	9.981095	63	9.479432	761	10.520568	10.018905	10.539473	13
48	9.460946	697	9.981057	63	9.479889	761	10.520111	10.018943	10.539054	12
49	9.461364	696	9.981019	63	9.480345	760	10.519655	10.018981	10.538636	11
50	9.461782	695	9.980981	65	9.480801	759	10.519199	10.019019	10.538218	10
51	9.462199	695	9.980942	63	9.481257	759	10.518743	10.019058	10.537801	9
52	9.462616	694	9.980904	63	9.481712	758	10.518288	10.019096	10.537384	8
53	9.463032	693	9.980866	65	9.482167	757	10.517833	10.019134	10.536968	7
54	9.463448	693	9.980827	63	9.482621	757	10.517379	10.019173	10.536552	6
55	9.463864	692	9.980789	65	9.483075	756	10.516925	10.019211	10.536136	5
56	9.464279	691	9.980750	63	9.483529	755	10.516471	10.019250	10.535721	4
57	9.464694	690	9.980712	65	9.483982	755	10.516018	10.019288	10.535306	3
58	9.465108	690	9.980673	63	9.484435	754	10.515565	10.019327	10.534892	2
59	9.465522	689	9.980635	65	9.484887	753	10.515113	10.019365	10.534478	1
60	9.465935		9.980596		9.485339		10.514661	10.019404	10.534065	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

73 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

17 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.465935	688	9.980596	63	9.485339	753	10.514661	10.019404	10.534065	60
1	9.466348	688	9.980558	65	9.485791	752	10.514209	10.019442	10.533652	59
2	9.466761	687	9.980519	65	9.486242	751	10.513758	10.019481	10.533239	58
3	9.467173	686	9.980480	63	9.486693	751	10.513307	10.019520	10.532827	57
4	9.467585	685	9.980442	65	9.487143	750	10.512857	10.019558	10.532415	56
5	9.467996	685	9.980403	65	9.487593	749	10.512407	10.019597	10.532004	55
6	9.468407	684	9.980364	65	9.488043	749	10.511957	10.019636	10.531593	54
7	9.468817	683	9.980325	65	9.488492	748	10.511508	10.019675	10.531183	53
8	9.469227	683	9.980286	65	9.488941	747	10.511059	10.019714	10.530773	52
9	9.469637	682	9.980247	65	9.489390	747	10.510610	10.019753	10.530363	51
10	9.470046	681	9.980208	65	9.489838	746	10.510162	10.019792	10.529954	50
11	9.470455	680	9.980169	65	9.490286	746	10.509714	10.019831	10.529545	49
12	9.470863	680	9.980130	65	9.490733	745	10.509267	10.019870	10.529137	48
13	9.471271	679	9.980091	65	9.491180	744	10.508820	10.019909	10.528729	47
14	9.471679	678	9.980052	67	9.491627	744	10.508373	10.019948	10.528321	46
15	9.472086	678	9.980012	65	9.492073	743	10.507927	10.019988	10.527914	45
16	9.472492	677	9.979973	65	9.492519	743	10.507481	10.020027	10.527508	44
17	9.472898	676	9.979934	65	9.492965	742	10.507035	10.020066	10.527102	43
18	9.473304	676	9.979895	67	9.493410	741	10.506590	10.020105	10.526696	42
19	9.473710	675	9.979855	65	9.493854	740	10.506146	10.020145	10.526290	41
20	9.474115	674	9.979816	67	9.494299	740	10.505701	10.020184	10.525885	40
21	9.474519	674	9.979776	65	9.494743	739	10.505257	10.020224	10.525481	39
22	9.474923	673	9.979737	67	9.495186	739	10.504814	10.020263	10.525077	38
23	9.475327	672	9.979697	65	9.495630	738	10.504370	10.020303	10.524673	37
24	9.475730	672	9.979658	67	9.496073	737	10.503927	10.020342	10.524270	36
25	9.476133	671	9.979618	65	9.496515	737	10.503485	10.020382	10.523867	35
26	9.476536	670	9.979579	67	9.496957	736	10.503043	10.020421	10.523464	34
27	9.476938	669	9.979539	67	9.497399	736	10.502601	10.020461	10.523062	33
28	9.477340	669	9.979499	67	9.497841	735	10.502159	10.020501	10.522660	32
29	9.477741	668	9.979459	65	9.498282	734	10.501718	10.020541	10.522259	31
30	9.478142	667	9.979420	67	9.498722	734	10.501278	10.020580	10.521858	30
31	9.478542	667	9.979380	67	9.499163	733	10.500837	10.020620	10.521458	29
32	9.478942	666	9.979340	67	9.499603	733	10.500397	10.020660	10.521058	28
33	9.479342	665	9.979300	67	9.500042	732	10.499958	10.020700	10.520658	27
34	9.479741	665	9.979260	67	9.500481	731	10.499519	10.020740	10.520259	26
35	9.480140	664	9.979220	67	9.500920	731	10.499080	10.020780	10.519860	25
36	9.480539	663	9.979180	67	9.501359	730	10.498641	10.020820	10.519461	24
37	9.480937	663	9.979140	67	9.501797	730	10.498203	10.020860	10.519063	23
38	9.481334	662	9.979100	68	9.502235	729	10.497765	10.020900	10.518666	22
39	9.481731	661	9.979059	67	9.502672	728	10.497328	10.020941	10.518269	21
40	9.482128	661	9.979019	67	9.503109	728	10.496891	10.020981	10.517872	20
41	9.482525	660	9.978979	67	9.503546	727	10.496454	10.021021	10.517475	19
42	9.482921	659	9.978939	68	9.503982	727	10.496018	10.021061	10.517079	18
43	9.483316	659	9.978898	67	9.504418	726	10.495582	10.021102	10.516684	17
44	9.483712	658	9.978858	68	9.504854	725	10.495146	10.021142	10.516288	16
45	9.484107	657	9.978817	67	9.505289	725	10.494711	10.021183	10.515893	15
46	9.484501	657	9.978777	67	9.505724	724	10 494276	10.021223	10.515499	14
47	9.484895	656	9.978737	68	9.506159	724	10.493841	10.021263	10.515105	13
48	9.485289	655	9.978696	68	9.506593	723	10.493407	10.021304	10.514711	12
49	9.485682	655	9.978655	67	9.507027	722	10.492973	10.021345	10.514318	11
50	9.486075	654	9.978615	68	9.507460	722	10.492540	10.021385	10.513925	10
51	9.486467	653	9.978574	68	9.507893	721	10.492107	10.021426	10.513533	9
52	9.486860	653	9.978533	67	9.508326	721	10.491674	10.021467	10.513140	8
53	9.487251	652	9.978493	68	9.508759	720	10.491241	10.021507	10.512749	7
54	9.487643	651	9.978452	68	9.509191	719	10.490809	10.021548	10.512357	6
55	9.488034	651	9.978411	68	9.509622	719	10.490378	10.021589	10.511966	5
56	9.488424	650	9.978370	68	9.510054	718	10.489946	10.021630	10.511576	4
57	9.488814	650	9.978329	68	9.510485	718	10.489515	10.021671	10.511186	3
58	9.489204	649	9.978288	68	9.510916	717	10.489084	10.021712	10.510796	2
59	9.489593	648	9.978247	68	9.511346	717	10.488654	10.021753	10.510407	1
60	9.489982		9.978206		9.511776		10.488224	10.021794	10.510018	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

72 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

18 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.489982	648	9.978206	68	9.511776	716	10.488224	10.021794	10.510018	60
1	9.490371	648	9.978165	68	9.512206	716	10.487794	10.021835	10.509629	59
2	9.490759	647	9.978124	68	9.512635	715	10.487365	10.021876	10.509241	58
3	9.491147	646	9.978083	69	9.513064	714	10.486936	10.021917	10.508853	57
4	9.491535	646	9.978042	69	9.513493	714	10.486507	10.021958	10.508465	56
5	9.491922	645	9.978001	69	9.513921	713	10.486079	10.021999	10.508078	55
6	9.492308	644	9.977959	69	9.514349	713	10.485651	10.022041	10.507692	54
7	9.492695	644	9.977918	69	9.514777	712	10.485223	10.022082	10.507305	53
8	9.493081	643	9.977877	69	9.515204	712	10.484796	10.022123	10.506919	52
9	9.493466	642	9.977835	69	9.515631	711	10.484369	10.022165	10.506534	51
10	9.493851	642	9.977794	69	9.516057	710	10.483943	10.022206	10.506149	50
11	9.494236	641	9.977752	69	9.516484	710	10.483516	10.022248	10.505764	49
12	9.494621	641	9.977711	69	9.516910	709	10.483090	10.022289	10.505379	48
13	9.495005	640	9.977669	69	9.517335	709	10.482665	10.022331	10.504995	47
14	9.495388	639	9.977628	69	9.517761	708	10.482239	10.022372	10.504612	46
15	9.495772	639	9.977586	69	9.518185	708	10.481815	10.022414	10.504228	45
16	9.496154	638	9.977544	70	9.518610	707	10.481390	10.022456	10.503846	44
17	9.496537	637	9.977503	70	9.519034	706	10.480966	10.022497	10.503463	43
18	9.496919	637	9.977461	70	9.519458	706	10.480542	10.022539	10.503081	42
19	9.497301	636	9.977419	70	9.519882	705	10.480118	10.022581	10.502699	41
20	9.497682	636	9.977377	70	9.520305	705	10.479695	10.022623	10.502318	40
21	9.498064	635	9.977335	70	9.520728	704	10.479272	10.022665	10.501936	39
22	9.498444	634	9.977293	70	9.521151	704	10.478849	10.022707	10.501556	38
23	9.498825	634	9.977251	70	9.521573	703	10.478427	10.022749	10.501175	37
24	9.499204	633	9.977209	70	9.521995	703	10.478005	10.022791	10.500796	36
25	9.499584	632	9.977167	70	9.522417	702	10.477583	10.022833	10.500416	35
26	9.499963	632	9.977125	70	9.522838	702	10.477162	10.022875	10.500037	34
27	9.500342	631	9.977083	70	9.523259	701	10.476741	10.022917	10.499658	33
28	9.500721	631	9.977041	70	9.523680	701	10.476320	10.022959	10.499279	32
29	9.501099	630	9.976999	70	9.524100	700	10.475900	10.023001	10.498901	31
30	9.501476	629	9.976957	70	9.524520	699	10.475480	10.023043	10.498524	30
31	9.501854	629	9.976914	70	9.524939	699	10.475061	10.023086	10.498146	29
32	9.502231	628	9.976872	70	9.525359	698	10.474641	10.023128	10.497769	28
33	9.502607	628	9.976830	71	9.525778	698	10.474222	10.023170	10.497393	27
34	9.502984	627	9.976787	71	9.526197	697	10.473803	10.023213	10.497016	26
35	9.503360	626	9.976745	71	9.526615	697	10.473385	10.023255	10.496640	25
36	9.503735	626	9.976702	71	9.527033	696	10.472967	10.023298	10.496265	24
37	9.504110	625	9.976660	71	9.527451	696	10.472549	10.023340	10.495890	23
38	9.504485	625	9.976617	71	9.527868	695	10.472132	10.023383	10.495515	22
39	9.504860	624	9.976574	71	9.528285	695	10.471715	10.023426	10.495140	21
40	9.505234	623	9.976532	71	9.528702	694	10.471298	10.023468	10.494766	20
41	9.505608	623	9.976489	71	9.529119	694	10.470881	10.023511	10.494392	19
42	9.505981	622	9.976446	71	9.529535	693	10.470465	10.023554	10.494019	18
43	9.506354	622	9.976404	71	9.529950	693	10.470050	10.023596	10.493646	17
44	9.506727	621	9.976361	71	9.530366	692	10.469634	10.023639	10.493273	16
45	9.507099	620	9.976318	71	9.530781	691	10.469219	10.023682	10.492901	15
46	9.507471	620	9.976275	71	9.531196	691	10.468804	10.023725	10.492529	14
47	9.507843	619	9.976232	72	9.531611	690	10.468389	10.023768	10.492157	13
48	9.508214	619	9.976189	72	9.532025	690	10.467975	10.023811	10.491786	12
49	9.508585	618	9.976146	72	9.532439	689	10.467561	10.023854	10.491415	11
50	9.508956	618	9.976103	72	9.532853	689	10.467147	10.023897	10.491044	10
51	9.509326	617	9.976060	72	9.533266	688	10.466734	10.023940	10.490674	9
52	9.509696	616	9.976017	72	9.533679	688	10.466321	10.023983	10.490304	8
53	9.510065	616	9.975974	72	9.534092	687	10.465908	10.024026	10.489935	7
54	9.510434	615	9.975930	72	9.534504	687	10.465496	10.024070	10.489566	6
55	9.510803	615	9.975887	72	9.534916	686	10.465084	10.024113	10.489197	5
56	9.511172	614	9.975844	72	9.535328	686	10.464672	10.024156	10.488828	4
57	9.511540	613	9.975800	72	9.535739	685	10.464261	10.024200	10.488460	3
58	9.511907	613	9.975757	72	9.536150	685	10.463850	10.024243	10.488093	2
59	9.512275	612	9.975714	72	9.536561	684	10.463439	10.024286	10.487725	1
60	9.512642		9.975670		9.536972		10.463028	10.024330	10.487358	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

71 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

19 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.512642	612	9.975670	72	9.536972	684	10.463028	10.024330	10.487358	60
1	9.513009	611	9.975627	73	9.537382	683	10.462618	10.024373	10.486991	59
2	9.513375	611	9.975583	73	9.537792	683	10.462208	10.024417	10.486625	58
3	9.513741	610	9.975539	73	9.538202	682	10.461798	10.024461	10.486259	57
4	9.514107	609	9.975495	73	9.538611	682	10.461389	10.024504	10.485893	56
5	9.514472	609	9.975452	73	9.539020	681	10.460980	10.024548	10.485528	55
6	9.514837	608	9.975408	73	9.539429	681	10.460571	10.024592	10.485163	54
7	9.515202	608	9.975365	73	9.539837	680	10.460163	10.024635	10.484798	53
8	9.515566	607	9.975321	73	9.540245	680	10.459755	10.024679	10.484434	52
9	9.515930	607	9.975277	73	9.540653	679	10.459347	10.024723	10.484070	51
10	9.516294	606	9.975233	73	9.541061	679	10.458939	10.024767	10.483706	50
11	9.516657	605	9.975189	73	9.541468	678	10.458532	10.024811	10.483343	49
12	9.517020	605	9.975145	73	9.541875	678	10.458125	10.024855	10.482980	48
13	9.517382	604	9.975101	73	9.542281	677	10.457719	10.024899	10.482618	47
14	9.517745	604	9.975057	73	9.542688	677	10.457312	10.024943	10.482255	46
15	9.518107	603	9.975013	73	9.543094	676	10.456906	10.024987	10.481893	45
16	9.518468	603	9.974969	74	9.543499	676	10.456501	10.025031	10.481532	44
17	9.518829	602	9.974925	74	9.543905	675	10.456095	10.025075	10.481171	43
18	9.519190	601	9.974880	74	9.544310	675	10.455690	10.025120	10.480810	42
19	9.519551	601	9.974836	74	9.544715	674	10.455285	10.025164	10.480449	41
20	9.519911	600	9.974792	74	9.545119	674	10.454881	10.025208	10.480089	40
21	9.520271	600	9.974748	74	9.545524	673	10.454476	10.025252	10.479729	39
22	9.520631	599	9.974703	74	9.545928	673	10.454072	10.025297	10.479369	38
23	9.520990	599	9.974659	74	9.546331	672	10.453669	10.025341	10.479010	37
24	9.521349	598	9.974614	74	9.546735	672	10.453265	10.025386	10.478651	36
25	9.521707	598	9.974570	74	9.547138	671	10.452862	10.025430	10.478293	35
26	9.522066	597	9.974525	74	9.547540	671	10.452460	10.025475	10.477934	34
27	9.522424	596	9.974481	74	9.547943	670	10.452057	10.025519	10.477576	33
28	9.522781	596	9.974436	74	9.548345	670	10.451655	10.025564	10.477219	32
29	9.523138	595	9.974391	74	9.548747	669	10.451253	10.025609	10.476862	31
30	9.523495	595	9.974347	75	9.549149	669	10.450851	10.025653	10.476505	30
31	9.523852	594	9.974302	75	9.549550	668	10.450450	10.025698	10.476148	29
32	9.524208	594	9.974257	75	9.549951	668	10.450049	10.025743	10.475792	28
33	9.524564	593	9.974212	75	9.550352	667	10.449648	10.025788	10.475436	27
34	9.524920	593	9.974167	75	9.550752	667	10.449248	10.025833	10.475080	26
35	9.525275	592	9.974122	75	9.551152	666	10.448848	10.025878	10.474725	25
36	9.525630	591	9.974077	75	9.551552	666	10.448448	10.025923	10.474370	24
37	9.525984	591	9.974032	75	9.551952	665	10.448048	10.025968	10.474016	23
38	9.526339	590	9.973987	75	9.552351	665	10.447649	10.026013	10.473661	22
39	9.526693	590	9.973942	75	9.552750	665	10.447250	10.026058	10.473307	21
40	9.527046	589	9.973897	75	9.553149	664	10.446851	10.026103	10.472954	20
41	9.527400	589	9.973852	75	9.553548	664	10.446452	10.026148	10.472600	19
42	9.527753	588	9.973807	75	9.553946	663	10.446054	10.026193	10.472247	18
43	9.528105	588	9.973761	75	9.554344	663	10.445656	10.026239	10.471895	17
44	9.528458	587	9.973716	76	9.554741	662	10.445259	10.026284	10.471542	16
45	9.528810	587	9.973671	76	9.555139	662	10.444861	10.026329	10.471190	15
46	9.529161	586	9.973625	76	9.555536	661	10.444464	10.026375	10.470839	14
47	9.529513	586	9.973580	76	9.555933	661	10.444067	10.026420	10.470487	13
48	9.529864	585	9.973535	76	9.556329	660	10.443671	10.026465	10.470136	12
49	9.530215	585	9.973489	76	9.556725	660	10.443275	10.026511	10.469785	11
50	9.530565	584	9.973444	76	9.557121	659	10.442879	10.026556	10.469435	10
51	9.530915	584	9.973398	76	9.557517	659	10.442483	10.026602	10.469085	9
52	9.531265	583	9.973352	76	9.557913	659	10.442087	10.026648	10.468735	8
53	9.531614	582	9.973307	76	9.558308	658	10.441692	10.026693	10.468386	7
54	9.531963	582	9.973261	76	9.558702	658	10.441298	10.026739	10.468037	6
55	9.532312	581	9.973215	76	9.559097	657	10.440903	10.026785	10.467688	5
56	9.532661	581	9.973169	76	9.559491	657	10.440509	10.026831	10.467339	4
57	9.533009	580	9.973124	76	9.559885	656	10.440115	10.026876	10.466991	3
58	9.533357	580	9.973078	76	9.560279	656	10.439721	10.026922	10.466643	2
59	9.533704	579	9.973032	76	9.560673	655	10.439327	10.026968	10.466296	1
60	9.534052		9.972986		9.561066		10.438934	10.027014	10.465948	0
M	Co-sine.		Sine.		Co-tang.		Tang.	Co-sec.	Secant.	M

70 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

20 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.534052	578	9.972986	77	9.561066	655	10.438934	10.027014	10.465948	60
1	9.534399	577	9.972940	77	9.561459	654	10.438541	10.027060	10.465601	59
2	9.534745	577	9.972894	77	9.561851	654	10.438149	10.027106	10.465255	58
3	9.535092	577	9.972848	77	9.562244	653	10.437756	10.027152	10.464908	57
4	9.535438	576	9.972802	78	9.562636	653	10.437364	10.027198	10.464562	56
5	9.535783	576	9.972755	77	9.563028	653	10.436972	10.027245	10.464217	55
6	9.536129	575	9.972709	77	9.563419	652	10.436581	10.027291	10.463871	54
7	9.536474	574	9.972663	77	9.563811	652	10.436189	10.027337	10.463526	53
8	9.536818	574	9.972617	78	9.564202	651	10.435798	10.027383	10.463182	52
9	9.537163	573	9.972570	77	9.564592	651	10.435408	10.027430	10.462837	51
10	9.537507	573	9.972524	77	9.564983	650	10.435017	10.027476	10.462493	50
11	9.537851	572	9.972478	78	9.565373	650	10.434627	10.027522	10.462149	49
12	9.538194	572	9.972431	77	9.565763	649	10.434237	10.027569	10.461806	48
13	9.538538	571	9.972385	78	9.566153	649	10.433847	10.027615	10.461462	47
14	9.538880	571	9.972338	78	9.566542	649	10.433458	10.027662	10.461120	46
15	9.539223	570	9.972291	77	9.566932	648	10.433068	10.027709	10.460777	45
16	9.539565	570	9.972245	78	9.567320	648	10.432680	10.027755	10.460435	44
17	9.539907	569	9.972198	78	9.567709	647	10.432291	10.027802	10.460093	43
18	9.540249	569	9.972151	77	9.568098	647	10.431902	10.027849	10.459751	42
19	9.540590	568	9.972105	78	9.568486	646	10.431514	10.027895	10.459410	41
20	9.540931	568	9.972058	78	9.568873	646	10.431127	10.027942	10.459069	40
21	9.541272	567	9.972011	78	9.569261	645	10.430739	10.027989	10.458728	39
22	9.541613	567	9.971964	78	9.569648	645	10.430352	10.028036	10.458387	38
23	9.541953	566	9.971917	78	9.570035	645	10.429965	10.028083	10.458047	37
24	9.542293	566	9.971870	78	9.570422	644	10.429578	10.028130	10.457707	36
25	9.542632	565	9.971823	78	9.570809	644	10.429191	10.028177	10.457368	35
26	9.542971	565	9.971776	78	9.571195	643	10.428805	10.028224	10.457029	34
27	9.543310	564	9.971729	78	9.571581	643	10.428419	10.028271	10.456690	33
28	9.543649	564	9.971682	78	9.571967	642	10.428033	10.028318	10.456351	32
29	9.543987	563	9.971635	78	9.572352	642	10.427648	10.028365	10.456013	31
30	9.544325	563	9.971588	80	9.572738	642	10.427262	10.028412	10.455675	30
31	9.544663	562	9.971540	78	9.573123	641	10.426877	10.028460	10.455337	29
32	9.545000	562	9.971493	78	9.573507	641	10.426493	10.028507	10.455000	28
33	9.545338	561	9.971446	80	9.573892	640	10.426108	10.028554	10.454662	27
34	9.545674	561	9.971398	78	9.574276	640	10.425724	10.028602	10.454326	26
35	9.546011	560	9.971351	80	9.574660	639	10.425340	10.028649	10.453989	25
36	9.546347	560	9.971303	78	9.575044	639	10.424956	10.028697	10.453653	24
37	9.546683	559	9.971256	80	9.575427	639	10.424573	10.028744	10.453317	23
38	9.547019	559	9.971208	78	9.575810	638	10.424190	10.028792	10.452981	22
39	9.547354	558	9.971161	80	9.576193	638	10.423807	10.028839	10.452646	21
40	9.547689	558	9.971113	78	9.576576	637	10.423424	10.028887	10.452311	20
41	9.548024	557	9.971066	80	9.576958	637	10.423042	10.028934	10.451976	19
42	9.548359	557	9.971018	80	9.577341	636	10.422659	10.028982	10.451641	18
43	9.548693	556	9.970970	80	9.577723	636	10.422277	10.029030	10.451307	17
44	9.549027	556	9.970922	80	9.578104	636	10.421896	10.029078	10.450973	16
45	9.549360	555	9.970874	78	9.578486	635	10.421514	10.029126	10.450640	15
46	9.549693	555	9.970827	80	9.578867	635	10.421133	10.029173	10.450307	14
47	9.550026	554	9.970779	80	9.579248	634	10.420752	10.029221	10.449974	13
48	9.550359	554	9.970731	80	9.579629	634	10.420371	10.029269	10.449641	12
49	9.550692	553	9.970683	80	9.580009	634	10.419991	10.029317	10.449308	11
50	9.551024	553	9.970635	82	9.580389	633	10.419611	10.029365	10.448976	10
51	9.551356	552	9.970586	80	9.580769	633	10.419231	10.029414	10.448644	9
52	9.551687	552	9.970538	80	9.581149	632	10.418851	10.029462	10.448313	8
53	9.552018	552	9.970490	80	9.581528	632	10.418472	10.029510	10.447982	7
54	9.552349	551	9.970442	80	9.581907	632	10.418093	10.029558	10.447651	6
55	9.552680	551	9.970394	82	9.582286	631	10.417714	10.029606	10.447320	5
56	9.553010	550	9.970345	80	9.582665	631	10.417335	10.029655	10.446990	4
57	9.553341	550	9.970297	80	9.583043	630	10.416957	10.029703	10.446659	3
58	9.553670	549	9.970249	82	9.583422	630	10.416578	10.029751	10.446330	2
59	9.554000	549	9.970200	80	9.583800	629	10.416200	10.029800	10.446000	1
60	9.554329		9.970152		9.584177		10.415823	10.029848	10.445671	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

69 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

21 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.554329	548	9.970152	81	9.584177	629	10.415823	10.029848	10.445671	60
1	9.554658	548	9.970103	81	9.584555	629	10.415445	10.029897	10.445342	59
2	9.554987	547	9.970055	81	9.584932	628	10.415068	10.029945	10.445013	58
3	9.555315	547	9.970006	81	9.585309	628	10.414691	10.029994	10.444685	57
4	9.555643	546	9.969957	81	9.585686	627	10.414314	10.030043	10.444357	56
5	9.555971	546	9.969909	81	9.586062	627	10.413938	10.030091	10.444029	55
6	9.556299	545	9.969860	81	9.586439	627	10.413561	10.030140	10.443701	54
7	9.556626	545	9.969811	81	9.586815	626	10.413185	10.030189	10.443374	53
8	9.556953	544	9.969762	81	9.587190	626	10.412810	10.030238	10.443047	52
9	9.557280	544	9.969714	81	9.587566	625	10.412434	10.030286	10.442720	51
10	9.557606	543	9.969665	81	9.587941	625	10.412059	10.030335	10.442394	50
11	9.557932	543	9.969616	82	9.588316	625	10.411684	10.030384	10.442068	49
12	9.558258	543	9.969567	82	9.588691	624	10.411309	10.030433	10.441742	48
13	9.558583	542	9.969518	82	9.589066	624	10.410934	10.030482	10.441417	47
14	9.558909	542	9.969469	82	9.589440	623	10.410560	10.030531	10.441091	46
15	9.559234	541	9.969420	82	9.589814	623	10.410186	10.030580	10.440766	45
16	9.559558	541	9.969370	82	9.590188	623	10.409812	10.030630	10.440442	44
17	9.559883	540	9.969321	82	9.590562	622	10.409438	10.030679	10.440117	43
18	9.560207	540	9.969272	82	9.590935	622	10.409065	10.030728	10.439793	42
19	9.560531	539	9.969223	82	9.591308	622	10.408692	10.030777	10.439469	41
20	9.560855	539	9.969173	82	9.591681	621	10.408319	10.030827	10.439145	40
21	9.561178	538	9.969124	82	9.592054	621	10.407946	10.030876	10.438822	39
22	9.561501	538	9.969075	82	9.592426	620	10.407574	10.030925	10.438499	38
23	9.561824	537	9.969025	82	9.592798	620	10.407202	10 030975	10.438176	37
24	9.562146	537	9.968976	82	9.593171	620	10.406829	10.031024	10.437854	36
25	9.562468	536	9.968926	83	9.593542	619	10.406458	10.031074	10.437532	35
26	9.562790	536	9.968877	83	9.593914	619	10.406086	10.031123	10.437210	34
27	9.563112	536	9.968827	83	9.594285	618	10.405715	10.031173	10.436888	33
28	9.563433	535	9.968777	83	9.594656	618	10.405344	10.031223	10.436567	32
29	9.563755	535	9.968728	83	9.595027	618	10.404973	10.031272	10.436245	31
30	9.564075	534	9.968678	83	9.595398	617	10.404602	10.031322	10.435925	30
31	9.564396	534	9.968628	83	9.595768	617	10.404232	10.031372	10.435604	29
32	9.564716	533	9.968578	83	9.596138	616	10.403862	10.031422	10.435284	28
33	9.565036	533	9.968528	83	9.596508	616	10.403492	10.031472	10.434964	27
34	9.565356	532	9.968479	83	9.596878	616	10.403122	10.031521	10.434644	26
35	9.565676	532	9.968429	83	9.597247	615	10.402753	10.031571	10.434324	25
36	9.565995	531	9.968379	83	9.597616	615	10.402384	10.031621	10.434005	24
37	9.566314	531	9.968329	83	9.597985	615	10.402015	10.031671	10.433686	23
38	9.566632	531	9.968278	83	9.598354	614	10.401646	10.031722	10.433368	22
39	9.566951	530	9.968228	84	9.598722	614	10.401278	10.031772	10.433049	21
40	9.567269	530	9.968178	84	9.599091	613	10.400909	10.031822	10.432731	20
41	9.567587	529	9.968128	84	9.599459	613	10.400541	10.031872	10.432413	19
42	9.567904	529	9.968078	84	9.599827	613	10.400173	10.031922	10.432096	18
43	9.568222	528	9.968027	84	9.600194	612	10.399806	10.031973	10.431778	17
44	9.568539	528	9.967977	84	9.600562	612	10.399438	10.032023	10.431461	16
45	9.568856	528	9.967927	84	9.600929	611	10.399071	10.032073	10.431144	15
46	9.569172	527	9.967876	84	9.601296	611	10 398704	10.032124	10.430828	14
47	9.569488	527	9.967826	84	9.601662	611	10.398338	10.032174	10.430512	13
48	9.569804	526	9.967775	84	9.602029	610	10.397971	10.032225	10.430196	12
49	9.570120	526	9.967725	84	9.602395	610	10.397605	10.032275	10.429880	11
50	9.570435	525	9.967674	84	9.602761	610	10.397239	10.032326	10.429565	10
51	9.570751	525	9.967624	84	9.603127	609	10.396873	10.032376	10.429249	9
52	9.571066	524	9.967573	84	9.603493	609	10.396507	10.032427	10.428934	8
53	9.571380	524	9.967522	85	9.603858	609	10.396142	10.032478	10.428620	7
54	9.571695	523	9.967471	85	9.604223	608	10.395777	10.032529	10.428305	6
55	9.572009	523	9.967421	85	9.604588	608	10.395412	10.032579	10.427991	5
56	9.572323	523	9.967370	85	9.604953	607	10.395047	10.032630	10.427677	4
57	9.572636	522	9.967319	85	9.605317	607	10.394683	10.032681	10.427364	3
58	9.572950	522	9.967268	85	9.605682	607	10.394318	10.032732	10.427050	2
59	9.573263	521	9.967217	85	9.606046	606	10.393954	10.032783	10.426737	1
60	9.573575		9.967166		9.606410		10.393590	10.032834	10.426425	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

68 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

22 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.573575	521	9.967166	85	9.606410	606	10.393590	10.032834	10.426425	60
1	9.573888	520	9.967115	85	9.606773	606	10.393227	10.032885	10.426112	59
2	9.574200	520	9.967064	85	9.607137	605	10.392863	10.032936	10.425800	58
3	9.574512	519	9.967013	85	9.607500	605	10.392500	10.032987	10.425488	57
4	9.574824	519	9.966961	85	9.607863	604	10.392137	10.033039	10.425176	56
5	9.575136	519	9.966910	85	9.608225	604	10.391775	10.033090	10.424864	55
6	9.575447	518	9.966859	85	9.608588	604	10.391412	10.033141	10.424553	54
7	9.575758	518	9.966808	85	9.608950	603	10.391050	10.033192	10.424242	53
8	9.576069	517	9.966756	86	9.609312	603	10.390688	10.033244	10.423931	52
9	9.576379	517	9.966705	86	9.609674	603	10.390326	10.033295	10.423621	51
10	9.576689	516	9.966653	86	9.610036	602	10.389964	10.033347	10.423311	50
11	9.576999	516	9.966602	86	9.610397	602	10.389603	10.033398	10.423001	49
12	9.577309	516	9.966550	86	9.610759	602	10.389241	10.033450	10.422691	48
13	9.577618	515	9.966499	86	9.611120	601	10.388880	10.033501	10.422382	47
14	9.577927	515	9.966447	86	9.611480	601	10.388520	10.033553	10.422073	46
15	9.578236	514	9.966395	86	9.611841	601	10.388159	10.033605	10.421764	45
16	9.578545	514	9.966344	86	9.612201	600	10.387799	10.033656	10.421455	44
17	9.578853	513	9.966292	86	9.612561	600	10.387439	10.033708	10.421147	43
18	9.579162	513	9.966240	86	9.612921	600	10.387079	10.033760	10.420838	42
19	9.579470	513	9.966188	86	9.613281	599	10.386719	10.033812	10.420530	41
20	9.579777	512	9.966136	86	9.613641	599	10.386359	10.033864	10.420223	40
21	9.580085	512	9.966085	87	9.614000	598	10.386000	10.033915	10.419915	39
22	9.580392	511	9.966033	87	9.614359	598	10.385641	10.033967	10.419608	38
23	9.580699	511	9.965981	87	9.614718	598	10.385282	10.034019	10.419301	37
24	9.581005	511	9.965929	87	9.615077	597	10.384923	10.034071	10.418995	36
25	9.581312	510	9.965876	87	9.615435	597	10.384565	10.034124	10.418688	35
26	9.581618	510	9.965824	87	9.615793	597	10.384207	10.034176	10.418382	34
27	9.581924	509	9.965772	87	9.616151	596	10.383849	10.034228	10.418076	33
28	9.582229	509	9.965720	87	9.616509	596	10.383491	10.034280	10.417771	32
29	9.582535	509	9.965668	87	9.616867	596	10.383133	10.034332	10.417465	31
30	9.582840	508	9.965615	87	9.617224	595	10.382776	10.034385	10.417160	30
31	9.583145	508	9.965563	87	9.617582	595	10.382418	10.034437	10.416855	29
32	9.583449	507	9.965511	87	9.617939	595	10.382061	10.034489	10.416551	28
33	9.583754	507	9.965458	87	9.618295	594	10.381705	10.034542	10.416246	27
34	9.584058	506	9.965406	87	9.618652	594	10.381348	10.034594	10.415942	26
35	9.584361	506	9.965353	88	9.619008	594	10.380992	10.034647	10.415639	25
36	9.584665	506	9.965301	88	9.619364	593	10.380636	10.034699	10.415335	24
37	9.584968	505	9.965248	88	9.619721	593	10.380279	10.034752	10.415032	23
38	9.585272	505	9.965195	88	9.620076	593	10.379924	10.034805	10.414728	22
39	9.585574	504	9.965143	88	9.620432	592	10.379568	10.034857	10.414426	21
40	9.585877	504	9.965090	88	9.620787	592	10.379213	10.034910	10.414123	20
41	9.586179	503	9.965037	88	9.621142	592	10.378858	10.034963	10.413821	19
42	9.586482	503	9.964984	88	9.621497	591	10.378503	10.035016	10.413518	18
43	9.586783	503	9.964931	88	9.621852	591	10.378148	10.035069	10.413217	17
44	9.587085	502	9.964879	88	9.622207	590	10.377793	10.035121	10.412915	16
45	9.587386	502	9.964826	88	9.622561	590	10.377439	10.035174	10.412614	15
46	9.587688	501	9.964773	88	9.622915	590	10.377085	10.035227	10.412312	14
47	9.587989	501	9.964720	88	9.623269	589	10.376731	10.035280	10.412011	13
48	9.588289	501	9.964666	89	9.623623	589	10.376377	10.035334	10.411711	12
49	9.588590	500	9.964613	89	9.623976	589	10.376024	10.035387	10.411410	11
50	9.588890	500	9.964560	89	9.624330	588	10.375670	10.035440	10.411110	10
51	9.589190	499	9.964507	89	9.624683	588	10.375317	10.035493	10.410810	9
52	9.589489	499	9.964454	89	9.625036	588	10.374964	10.035546	10.410511	8
53	9.589789	499	9.964400	89	9.625388	587	10.374612	10.035600	10.410211	7
54	9.590088	498	9.964347	89	9.625741	587	10.374259	10.035653	10.409912	6
55	9.590387	498	9.964294	89	9.626093	587	10.373907	10.035706	10.409613	5
56	9.590686	497	9.964240	89	9.626445	586	10.373555	10.035760	10.409314	4
57	9.590984	497	9.964187	89	9.626797	586	10.373203	10.035813	10.409016	3
58	9.591282	497	9.964133	89	9.627149	586	10.372851	10.035867	10.408718	2
59	9.591580	496	9.964080	89	9.627501	585	10.372499	10.035920	10.408420	1
60	9.591878		9.964026		9.627852		10.372148	10.035974	10.408122	0
M	Co-sine.		Sine.		Co-tang.		Tang.	Co-sec.	Secant.	M

67 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

23 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.591878	496	9.964026	89	9.627852	585	10.372148	10.035974	10.408122	60
1	9.592176	495	9.963972	89	9.628203	585	10.371797	10.036028	10.407824	59
2	9.592473	495	9.963919	89	9.628554	585	10.371446	10.036081	10.407527	58
3	9.592770	495	9.963865	90	9.628905	584	10.371095	10.036135	10.407230	57
4	9.593067	494	9.963811	90	9.629255	584	10.370745	10.036189	10.406933	56
5	9.593363	494	9.963757	90	9.629606	583	10.370394	10.036243	10.406637	55
6	9.593659	493	9.963704	90	9.629956	583	10.370044	10.036296	10.406341	54
7	9.593955	493	9.963650	90	9.630306	583	10.369694	10.036350	10.406045	53
8	9.594251	493	9.963596	90	9.630656	583	10.369344	10.036404	10.405749	52
9	9.594547	492	9.963542	90	9.631005	582	10.368995	10.036458	10.405453	51
10	9.594842	492	9.963488	90	9.631355	582	10.368645	10.036512	10.405158	50
11	9.595137	491	9.963434	90	9.631704	582	10.368296	10.036566	10.404863	49
12	9.595432	491	9.963379	90	9.632053	581	10.367947	10.036621	10.404568	48
13	9.595727	491	9.963325	90	9.632401	581	10.367599	10.036675	10.404273	47
14	9.596021	490	9.963271	90	9.632750	581	10.367250	10.036729	10.403979	46
15	9.596315	490	9.963217	90	9.633098	580	10.366902	10.036783	10.403685	45
16	9.596609	489	9.963163	90	9.633447	580	10.366553	10.036837	10.403391	44
17	9.596903	489	9.963108	91	9.633795	580	10.366205	10.036892	10.403097	43
18	9.597196	489	9.963054	91	9.634143	579	10.365857	10.036946	10.402804	42
19	9.597490	488	9.962999	91	9.634490	579	10.365510	10.037001	10.402510	41
20	9.597783	488	9.962945	91	9.634838	579	10.365162	10.037055	10.402217	40
21	9.598075	487	9.962890	91	9.635185	578	10.364815	10.037110	10.401925	39
22	9.598368	487	9.962836	91	9.635532	578	10.364468	10.037164	10.401632	38
23	9.598660	487	9.962781	91	9.635879	578	10.364121	10.037219	10.401340	37
24	9.598952	486	9.962727	91	9.636226	577	10.363774	10.037273	10.401048	36
25	9.599244	486	9.962672	91	9.636572	577	10.363428	10.037328	10.400756	35
26	9.599536	485	9.962617	91	9.636919	577	10.363081	10.037383	10.400464	34
27	9.599827	485	9.962562	91	9.637265	577	10.362735	10.037438	10.400173	33
28	9.600118	485	9.962508	91	9.637611	576	10.362389	10.037492	10.399882	32
29	9.600409	484	9.962453	91	9.637956	576	10.362044	10.037547	10.399591	31
30	9.600700	484	9.962398	92	9.638302	576	10.361698	10.037602	10.399300	30
31	9.600990	484	9.962343	92	9.638647	575	10.361353	10.037657	10.399010	29
32	9.601280	483	9.962288	92	9.638992	575	10.361008	10.037712	10.398720	28
33	9.601570	483	9.962233	92	9.639337	575	10.360663	10.037767	10.398430	27
34	9.601860	482	9.962178	92	9.639682	574	10.360318	10.037822	10.398140	26
35	9.602150	482	9.962123	92	9.640027	574	10.359973	10.037877	10.397850	25
36	9.602439	482	9.962067	92	9.640371	574	10.359629	10.037933	10.397561	24
37	9.602728	481	9.962012	92	9.640716	573	10.359284	10.037988	10.397272	23
38	9.603017	481	9.961957	92	9.641060	573	10.358940	10.038043	10.396983	22
39	9.603305	481	9.961902	92	9.641404	573	10.358596	10.038098	10.396695	21
40	9.603594	480	9.961846	92	9.641747	572	10.358253	10.038154	10.396406	20
41	9.603882	480	9.961791	92	9.642091	572	10.357909	10.038209	10.396118	19
42	9.604170	479	9.961735	92	9.642434	572	10.357566	10.038265	10.395830	18
43	9.604457	479	9.961680	92	9.642777	572	10.357223	10.038320	10.395543	17
44	9.604745	479	9.961624	93	9.643120	571	10.356880	10.038376	10.395255	16
45	9.605032	478	9.961569	93	9.643463	571	10.356537	10.038431	10.394968	15
46	9.605319	478	9.961513	93	9.643806	571	10.356194	10.038487	10.394681	14
47	9.605606	478	9.961458	93	9.644148	570	10.355852	10.038542	10.394394	13
48	9.605892	477	9.961402	93	9.644490	570	10.355510	10.038598	10.394108	12
49	9.606179	477	9.961346	93	9.644832	570	10.355168	10.038654	10.393821	11
50	9.606465	476	9.961290	93	9.645174	570	10.354826	10.038710	10.393535	10
51	9.606751	476	9.961235	93	9.645516	569	10.354484	10.038765	10.393249	9
52	9.607036	475	9.961179	93	9.645857	569	10.354143	10.038821	10.392964	8
53	9.607322	475	9.961123	93	9.646199	569	10.353801	10.038877	10.392678	7
54	9.607607	475	9.961067	93	9.646540	568	10.353460	10.038933	10.392393	6
55	9.607892	474	9.961011	93	9.646881	568	10.353119	10.038989	10.392108	5
56	9.608177	474	9.960955	93	9.647222	568	10.352778	10.039045	10 391823	4
57	9.608461	474	9.960899	93	9.647562	567	10.352438	10.039101	10.391539	3
58	9.608745	473	9.960843	94	9.647903	567	10.352097	10.039157	10.391255	2
59	9.609029	473	9.960786	94	9.648243	567	10.351757	10.039214	10.390971	1
60	9.609313		9.960730		9.648583		10.351417	10.039270	10.390687	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

66 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

24 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.609313	473	9.960730	94	9.648583	566	10.351417	10.039270	10.390687	60
1	9.609597	472	9.960674	94	9.648923	566	10.351077	10.039326	10.390403	59
2	9.609880	472	9.960618	94	9.649263	566	10.350737	10.039382	10.390120	58
3	9.610164	472	9.960561	94	9.649602	566	10.350398	10.039439	10.389836	57
4	9.610447	471	9.960505	94	9.649942	565	10.350058	10.039495	10.389553	56
5	9.610729	471	9.960448	94	9.650281	565	10.349719	10.039552	10.389271	55
6	9.611012	470	9.960392	94	9.650620	565	10.349380	10.039608	10.388988	54
7	9.611294	470	9.960335	94	9.650959	564	10.349041	10.039665	10.388706	53
8	9.611576	470	9.960279	94	9.651297	564	10.348703	10.039721	10.388424	52
9	9.611858	469	9.960222	94	9.651636	564	10.348364	10.039778	10.388142	51
10	9.612140	469	9.960165	94	9.651974	563	10.348026	10.039835	10.387860	50
11	9.612421	469	9.960109	95	9.652312	563	10.347688	10.039891	10.387579	49
12	9.612702	468	9.960052	95	9.652650	563	10.347350	10.039948	10.387298	48
13	9.612983	468	9.959995	95	9.652988	563	10.347012	10.040005	10.387017	47
14	9.613264	467	9.959938	95	9.653326	562	10.346674	10.040062	10.386736	46
15	9.613545	467	9.959882	95	9.653663	562	10.346337	10.040118	10.386455	45
16	9.613825	467	9.959825	95	9.654000	562	10.346000	10.040175	10.386175	44
17	9.614105	466	9.959768	95	9.654337	561	10.345663	10.040232	10.385895	43
18	9.614385	466	9.959711	95	9.654674	561	10.345326	10.040289	10.385615	42
19	9.614665	466	9.959654	95	9.655011	561	10.344989	10.040346	10.385335	41
20	9.614944	465	9.959596	95	9.655348	561	10.344652	10.040404	10.385056	40
21	9.615223	465	9.959539	95	9.655684	560	10.344316	10.040461	10.384777	39
22	9.615502	465	9.959482	95	9.656020	560	10.343980	10.040518	10.384498	38
23	9.615781	464	9.959425	95	9.656356	560	10.343644	10.040575	10.384219	37
24	9.616060	464	9.959368	95	9.656692	559	10.343308	10.040632	10.383940	36
25	9.616338	464	9.959310	96	9.657028	559	10.342972	10.040690	10.383662	35
26	9.616616	463	9.959253	96	9.657364	559	10.342636	10.040747	10.383384	34
27	9.616894	463	9.959195	96	9.657699	559	10.342301	10.040805	10.383106	33
28	9.617172	462	9.959138	96	9.658034	558	10.341966	10.040862	10.382828	32
29	9.617450	462	9.959080	96	9.658369	558	10.341631	10.040919	10.382550	31
30	9.617727	462	9.959023	96	9.658704	558	10.341296	10.040977	10.382273	30
31	9.618004	461	9.958965	96	9.659039	558	10.340961	10.041035	10.381996	29
32	9.618281	461	9.958908	96	9.659373	557	10.340627	10.041092	10.381719	28
33	9.618558	461	9.958850	96	9.659708	557	10.340292	10.041150	10.381442	27
34	9.618834	460	9.958792	96	9.660042	557	10.339958	10.041208	10.381166	26
35	9.619110	460	9.958734	96	9.660376	556	10.339624	10.041266	10.380890	25
36	9.619386	460	9.958677	96	9.660710	556	10.339290	10.041323	10.380614	24
37	9.619662	459	9.958619	96	9.661043	556	10.338957	10.041381	10.380338	23
38	9.619938	459	9.958561	96	9.661377	556	10.338623	10.041439	10.380062	22
39	9.620213	459	9.958503	97	9.661710	555	10.338290	10.041497	10.379787	21
40	9.620488	458	9.958445	97	9.662043	555	10.337957	10.041555	10.379512	20
41	9.620763	458	9.958387	97	9.662376	555	10.337624	10.041613	10.379237	19
42	9.621038	457	9.958329	97	9.662709	554	10.337291	10.041671	10.378962	18
43	9.621313	457	9.958271	97	9.663042	554	10.336958	10.041729	10.378687	17
44	9.621587	457	9.958213	97	9.663375	554	10.336625	10.041787	10.378413	16
45	9.621861	456	9.958154	97	9.663707	554	10.336293	10.041846	10.378139	15
46	9.622135	456	9.958096	97	9.664039	553	10.335961	10.041904	10.377865	14
47	9.622409	456	9.958038	97	9.664371	553	10.335629	10.041962	10.377591	13
48	9.622682	455	9.957979	97	9.664703	553	10.335297	10.042021	10.377318	12
49	9.622956	455	9.957921	97	9.665035	553	10.334965	10.042079	10.377044	11
50	9.623229	455	9.957863	97	9.665366	552	10.334634	10.042137	10.376771	10
51	9.623502	454	9.957804	97	9.665697	552	10.334303	10.042196	10.376498	9
52	9.623774	454	9.957746	98	9.666029	552	10.333971	10.042254	10.376226	8
53	9.624047	454	9.957687	98	9.666360	551	10.333640	10.042313	10.375953	7
54	9.624319	453	9.957628	98	9.666691	551	10.333309	10.042372	10.375681	6
55	9.624591	453	9.957570	98	9.667021	551	10.332979	10.042430	10.375409	5
56	9.624863	453	9.957511	98	9.667352	551	10.332648	10.042489	10.375137	4
57	9.625135	452	9.957452	98	9.667682	550	10.332318	10.042548	10.374865	3
58	9.625406	452	9.957393	98	9.668013	550	10.331987	10.042607	10.374594	2
59	9.625677	452	9.957335	98	9.668343	550	10.331657	10.042665	10.374323	1
60	9.625948		9.957276		9.668672		10.331328	10.042724	10.374052	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

65 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

25 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.625948	451	9.957276	98	9.668672	550	10.331328	10.042724	10.374052	60
1	9.626219	451	9.957217	98	9.669002	549	10.330998	10.042783	10.373781	59
2	9.626490	451	9.957158	98	9.669332	549	10.330668	10.042842	10.373510	58
3	9.626760	450	9.957099	98	9.669661	549	10.330339	10.042901	10.373240	57
4	9.627030	450	9.957040	98	9.669991	548	10.330009	10.042960	10.372970	56
5	9.627300	450	9.956981	98	9.670320	548	10.329680	10.043019	10.372700	55
6	9.627570	449	9.956921	99	9.670649	548	10.329351	10.043079	10.372430	54
7	9.627840	449	9.956862	99	9.670977	548	10.329023	10.043138	10.372160	53
8	9.628109	449	9.956803	99	9.671306	547	10.328694	10.043197	10.371891	52
9	9.628378	448	9.956744	99	9.671634	547	10.328366	10.043256	10.371622	51
10	9.628647	448	9.956684	99	9.671963	547	10.328037	10.043316	10.371353	50
11	9.628916	448	9.956625	99	9.672291	547	10.327709	10.043375	10.371084	49
12	9.629185	447	9.956566	99	9.672619	546	10.327381	10.043434	10.370815	48
13	9.629453	447	9.956506	99	9.672947	546	10.327053	10.043494	10.370547	47
14	9.629721	447	9.956447	99	9.673274	546	10.326726	10.043553	10.370279	46
15	9.629989	446	9.956387	99	9.673602	546	10.326398	10.043613	10.370011	45
16	9.630257	446	9.956327	99	9.673929	545	10.326071	10.043673	10.369743	44
17	9.630524	446	9.956268	99	9.674257	545	10.325743	10.043732	10.369476	43
18	9.630792	445	9.956208	100	9.674584	545	10.325416	10.043792	10.369208	42
19	9.631059	445	9.956148	100	9.674910	544	10.325090	10.043852	10.368941	41
20	9.631326	445	9.956089	100	9.675237	544	10.324763	10.043911	10.368674	40
21	9.631593	444	9.956029	100	9.675564	544	10.324436	10.043971	10.368407	39
22	9.631859	444	9.955969	100	9.675890	544	10.324110	10.044031	10.368141	38
23	9.632125	444	9.955909	100	9.676217	543	10.323783	10.044091	10.367875	37
24	9.632392	443	9.955849	100	9.676543	543	10.323457	10.044151	10.367608	36
25	9.632658	443	9.955789	100	9.676869	543	10.323131	10.044211	10.367342	35
26	9.632923	443	9.955729	100	9.677194	543	10.322806	10.044271	10.367077	34
27	9.633189	442	9.955669	100	9.677520	542	10.322480	10.044331	10.366811	33
28	9.633454	442	9.955609	100	9.677846	542	10.322154	10.044391	10.366546	32
29	9.633719	442	9.955548	100	9.678171	542	10.321829	10.044452	10.366281	31
30	9.633984	441	9.955488	100	9.678496	542	10.321504	10.044512	10.366016	30
31	9.634249	441	9.955428	101	9.678821	541	10.321179	10.044572	10.365751	29
32	9.634514	440	9.955368	101	9.679146	541	10.320854	10.044632	10.365486	28
33	9.634778	440	9.955307	101	9.679471	541	10.320529	10.044693	10.365222	27
34	9.635042	440	9.955247	101	9.679795	541	10.320205	10.044753	10.364958	26
35	9.635306	439	9.955186	101	9.680120	540	10.319880	10.044814	10.364694	25
36	9.635570	439	9.955126	101	9.680444	540	10.319556	10.044874	10.364430	24
37	9.635834	439	9.955065	101	9.680768	540	10.319232	10.044935	10.364166	23
38	9.636097	438	9.955005	101	9.681092	540	10.318908	10.044995	10.363903	22
39	9.636360	438	9.954944	101	9.681416	539	10.318584	10.045056	10.363640	21
40	9.636623	438	9.954883	101	9.681740	539	10.318260	10.045117	10.363377	20
41	9.636886	437	9.954823	101	9.682063	539	10.317937	10.045177	10.363114	19
42	9.637148	437	9.954762	101	9.682387	539	10.317613	10.045238	10.362852	18
43	9.637411	437	9.954701	101	9.682710	538	10.317290	10.045299	10.362589	17
44	9.637673	437	9.954640	101	9.683033	538	10.316967	10.045360	10.362327	16
45	9.637935	436	9.954579	101	9.683356	538	10.316644	10.045421	10.362065	15
46	9.638197	436	9.954518	102	9.683679	538	10.316321	10.045482	10.361803	14
47	9.638458	436	9.954457	102	9.684001	537	10.315999	10.045543	10.361542	13
48	9.638720	435	9.954396	102	9.684324	537	10.315676	10.045604	10.361280	12
49	9.638981	435	9.954335	102	9.684646	537	10.315354	10.045665	10.361019	11
50	9.639242	435	9.954274	102	9.684968	537	10.315032	10.045726	10.360758	10
51	9.639503	434	9.954213	102	9.685290	536	10.314710	10.045787	10.360497	9
52	9.639764	434	9.954152	102	9.685612	536	10.314388	10.045848	10.360236	8
53	9.640024	434	9.954090	102	9.685934	536	10.314066	10.045910	10.359976	7
54	9.640284	433	9.954029	102	9.686255	536	10.313745	10.045971	10.359716	6
55	9.640544	433	9.953968	102	9.686577	535	10.313423	10.046032	10.359456	5
56	9.640804	433	9.953906	102	9.686898	535	10.313102	10.046094	10.359196	4
57	9.641064	432	9.953845	102	9.687219	535	10.312781	10.046155	10.358936	3
58	9.641324	432	9.953783	102	9.687540	535	10.312460	10.046217	10.358676	2
59	9.641583	432	9.953722	103	9.687861	534	10.312139	10.046278	10.358417	1
60	9.641842		9.953660		9.688182		10.311818	10.046340	10.358158	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

64 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

26 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.641842	431	9.953660	103	9.688182	534	10.311818	10.046340	10.358158	60
1	9.642101	431	9.953599	103	9.688502	534	10.311498	10.046401	10.357899	59
2	9.642360	431	9.953537	103	9.688823	534	10.311177	10.046463	10.357640	58
3	9.642618	430	9.953475	103	9.689143	533	10.310857	10.046525	10.357382	57
4	9.642877	430	9.953413	103	9.689463	533	10.310537	10.046587	10.357123	56
5	9.643135	430	9.953352	103	9.689783	533	10.310217	10.046648	10.356865	55
6	9.643393	430	9.953290	103	9.690103	533	10.309897	10.046710	10.356607	54
7	9.643650	429	9.953228	103	9.690423	533	10.309577	10.046772	10.356350	53
8	9.643908	429	9.953166	103	9.690742	532	10.309258	10.046834	10.356092	52
9	9.644165	429	9.953104	103	9.691062	532	10.308938	10.046896	10.355835	51
10	9.644423	428	9.953042	103	9.691381	532	10.308619	10.046958	10.355577	50
11	9.644680	428	9.952980	104	9.691700	532	10.308300	10.047020	10.355320	49
12	9.644936	428	9.952918	104	9.692019	531	10.307981	10.047082	10.355064	48
13	9.645193	427	9.952855	104	9.692338	531	10.307662	10.047145	10.354807	47
14	9.645450	427	9.952793	104	9.692656	531	10.307344	10.047207	10.354550	46
15	9.645706	427	9.952731	104	9.692975	531	10.307025	10.047269	10.354294	45
16	9.645962	426	9.952669	104	9.693293	530	10.306707	10.047331	10.354038	44
17	9.646218	426	9.952606	104	9.693612	530	10.306388	10.047394	10.353782	43
18	9.646474	426	9.952544	104	9.693930	530	10.306070	10.047456	10.353526	42
19	9.646729	425	9.952481	104	9.694248	530	10.305752	10.047519	10.353271	41
20	9.646984	425	9.952419	104	9.694566	529	10.305434	10.047581	10.353016	40
21	9.647240	425	9.952356	104	9.694883	529	10.305117	10.047644	10.352760	39
22	9.647494	424	9.952294	104	9.695201	529	10.304799	10.047706	10.352506	38
23	9.647749	424	9.952231	104	9.695518	529	10.304482	10.047769	10.352251	37
24	9.648004	424	9.952168	105	9.695836	529	10.304164	10.047832	10.351996	36
25	9.648258	424	9.952106	105	9.696153	528	10.303847	10.047894	10.351742	35
26	9.648512	423	9.952043	105	9.696470	528	10.303530	10.047957	10.351488	34
27	9.648766	423	9.951980	105	9.696787	528	10.303213	10.048020	10.351234	33
28	9.649020	423	9.951917	105	9.697103	528	10.302897	10.048083	10.350980	32
29	9.649274	422	9.951854	105	9.697420	527	10.302580	10.048146	10.350726	31
30	9.649527	422	9.951791	105	9.697736	527	10.302264	10.048209	10.350473	30
31	9.649781	422	9.951728	105	9.698053	527	10.301947	10.048272	10.350219	29
32	9.650034	422	9.951665	105	9.698369	527	10.301631	10.048335	10.349966	28
33	9.650287	421	9.951602	105	9.698685	526	10.301315	10.048398	10.349713	27
34	9.650539	421	9.951539	105	9.699001	526	10.300999	10.048461	10.349461	26
35	9.650792	421	9.951476	105	9.699316	526	10.300684	10.048524	10.349208	25
36	9.651044	420	9.951412	105	9.699632	526	10.300368	10.048588	10.348956	24
37	9.651297	420	9.951349	106	9.699947	526	10.300053	10.048651	10.348703	23
38	9.651549	420	9.951286	106	9.700263	525	10.299737	10.048714	10.348451	22
39	9.651800	419	9.951222	106	9.700578	525	10.299422	10.048778	10.348200	21
40	9.652052	419	9.951159	106	9.700893	525	10.299107	10.048841	10.347948	20
41	9.652304	419	9.951096	106	9.701208	525	10.298792	10.048904	10.347696	19
42	9.652555	418	9.951032	106	9.701523	524	10.298477	10.048968	10.347445	18
43	9.652806	418	9.950968	106	9.701837	524	10.298163	10.049032	10.347194	17
44	9.653057	418	9.950905	106	9.702152	524	10.297848	10.049095	10.346943	16
45	9.653308	418	9.950841	106	9.702466	524	10.297534	10.049159	10.346692	15
46	9.653558	417	9.950778	106	9.702780	523	10.297220	10.049222	10.346442	14
47	9.653808	417	9.950714	106	9.703095	523	10.296905	10.049286	10.346192	13
48	9.654059	417	9.950650	106	9.703409	523	10.296591	10.049350	10.345941	12
49	9.654309	416	9.950586	106	9.703723	523	10.296277	10.049414	10.345691	11
50	9.654558	416	9.950522	107	9.704036	523	10.295964	10.049478	10.345442	10
51	9.654808	416	9.950458	107	9.704350	522	10.295650	10.049542	10.345192	9
52	9.655058	415	9.950394	107	9.704663	522	10.295337	10.049606	10.344942	8
53	9.655307	415	9.950330	107	9.704977	522	10.295023	10.049670	10.344693	7
54	9.655556	415	9.950266	107	9.705290	522	10.294710	10.049734	10.344444	6
55	9.655805	415	9.950202	107	9.705603	521	10.294397	10.049798	10.344195	5
56	9.656054	414	9.950138	107	9.705916	521	10.294084	10.049862	10.343946	4
57	9.656302	414	9.950074	107	9.706228	521	10.293772	10.049926	10.343698	3
58	9.656551	414	9.950010	107	9.706541	521	10.293459	10.049990	10.343449	2
59	9.656799	413	9.949945	107	9.706854	521	10.293146	10.050055	10.343201	1
60	9.657047		9.949881		9.707166		10.292834	10.050119	10.342953	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

63 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

27 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.657047	413	9.949881	107	9.707166	520	10.292834	10.050119	10.342953	60
1	9.657295	413	9.949816	107	9.707478	520	10.292522	10.050184	10.342765	59
2	9.657542	412	9.949752	107	9.707790	520	10.292210	10.050248	10.342458	58
3	9.657790	412	9.949688	108	9.708102	520	10.291898	10.050312	10.342210	57
4	9.658037	412	9.949623	108	9.708414	519	10.291586	10.050377	10.341963	56
5	9.658284	412	9.949558	108	9.708726	519	10.291274	10.050442	10.341716	55
6	9.658531	411	9.949494	108	9.709037	519	10.290963	10.050506	10.341469	54
7	9.658778	411	9.949429	108	9.709349	519	10.290651	10.050571	10.341222	53
8	9.659025	411	9.949364	108	9.709660	519	10.290340	10.050636	10.340975	52
9	9.659271	410	9.949300	108	9.709971	518	10.290029	10.050700	10.340729	51
10	9.659517	410	9.949235	108	9.710282	518	10.289718	10.050765	10.340483	50
11	9.659763	410	9.949170	108	9.710593	518	10.289407	10.050830	10.340237	49
12	9.660009	409	9.949105	108	9.710904	518	10.289096	10.050895	10.339991	48
13	9.660255	409	9.949040	108	9.711215	518	10.288785	10.050960	10.339745	47
14	9.660501	409	9.948975	108	9.711525	517	10.288475	10.051025	10.339499	46
15	9.660746	409	9.948910	108	9.711836	517	10.288164	10.051090	10.339254	45
16	9.660991	408	9.948845	108	9.712146	517	10.287854	10.051155	10.339009	44
17	9.661236	408	9.948780	109	9.712456	517	10.287544	10.051220	10.338764	43
18	9.661481	408	9.948715	109	9.712766	516	10.287234	10.051285	10.338519	42
19	9.661726	407	9.948650	109	9.713076	516	10.286924	10.051350	10.338274	41
20	9.661970	407	9.948584	109	9.713386	516	10.286614	10.051416	10.338030	40
21	9.662214	407·	9.948519	109	9.713696	516	10.286304	10.051481	10.337786	39
22	9.662459	407	9.948454	109	9.714005	516	10.285995	10.051546	10.337541	38
23	9.662703	406	9.948388	109	9.714314	515	10.285686	10.051612	10.337297	37
24	9.662946	406	9.948323	109	9.714624	515	10.285376	10.051677	10.337054	36
25	9.663190	406	9.948257	109	9.714933	515	10.285067	10.051743	10.336810	35
26	9.663433	405	9.948192	109	9.715242	515	10.284758	10.051808	10.336567	34
27	9.663677	405	9.948126	109	9.715551	514	10.284449	10.051874	10.336323	33
28	9.663920	405	9.948060	109	9.715860	514	10.284140	10.051940	10.336080	32
29	9.664163	405	9.947995	110	9.716168	514	10.283832	10.052005	10.335837	31
30	9.664406	404	9.947929	110	9.716477	514	10.283523	10.052071	10.335594	30
31	9.664648	404	9.947863	110	9.716785	514	10.283215	10.052137	10.335352	29
32	9.664891	404	9.947797	110	9.717093	513	10.282907	10.052203	10.335109	28
33	9.665133	403	9.947731	110	9.717401	513	10.282599	10.052269	10.334867	27
34	9.665375	403	9.947665	110	9.717709	513	10.282291	10.052335	10.334625	26
35	9.665617	403	9.947600	110	9.718017	513	10.281983	10.052400	10.334383	25
36	9.665859	402	9.947533	110	9.718325	513	10.281675	10.052467	10.334141	24
37	9.666100	402	9.947467	110	9.718633	512	10.281367	10.052533	10.333900	23
38	9.666342	402	9.947401	110	9.718940	512	10.281060	10.052599	10.333658	22
39	9.666583	402	9.947335	110	9.719248	512	10.280752	10.052665	10.333417	21
40	9.666824	401	9.947269	110	9.719555	512	10.280445	10.052731	10.333176	20
41	9.667065	401	9.947203	110	9.719862	512	10.280138	10.052797	10.332935	19
42	9.667305	401	9.947136	111	9.720169	511	10.279831	10.052864	10.332695	18
43	9.667546	401	9.947070	111	9.720476	511	10.279524	10.052930	10.332454	17
44	9.667786	400	9.947004	111	9.720783	511	10.279217	10.052996	10.332214	16
45	9.668027	400	9.946937	111	9.721089	511	10.278911	10.053063	10.331973	15
46	9.668267	400	9.946871	111	9.721396	511	10.278604	10.053129	10.331733	14
47	9.668506	399	9.946804	111	9.721702	510	10.278298	10.053196	10.331494	13
48	9.668746	399	9.946738	111	9.722009	510	10.277991	10.053262	10.331254	12
49	9.668986	399	9.946671	111	9.722315	510	10.277685	10.053329	10.331014	11
50	9.669225	399	9.946604	111	9.722621	510	10.277379	10.053396	10.330775	10
51	9.669464	398	9.946538	111	9.722927	510	10.277073	10.053462	10.330536	9
52	9.669703	398	9.946471	111	9.723232	509	10.276768	10.053529	10.330297	8
53	9.669942	398	9.946404	111	9.723538	509	10.276462	10.053596	10.330058	7
54	9.670181	397	9.946337	111	9.723844	509	10.276156	10.053663	10.329819	6
55	9.670419	397	9.946270	112	9.724149	509	10.275851	10.053730	10.329581	5
56	9.670658	397	9.946203	112	9.724454	509	10.275546	10.053797	10.329342	4
57	9.670896	397	9.946136	112	9.724759	508	10.275241	10.053864	10.329104	3
58	9.671134	396	9.946069	112	9.725065	508	10.274935	10.053931	10.328866	2
59	9.671372	396	9.946002	112	9.725369	508	10.274631	10.053998	10.328628	1
60	9.671609		9.945935		9.725674		10.274326	10.054065	10.328391	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

62 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

28 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.671609	396	9.945935	112	9.725674	508	10.274326	10.054065	10.328391	60
1	9.671847	395	9.945868	112	9.725979	508	10.274021	10.054132	10.328153	59
2	9.672084	395	9.945800	112	9.726284	507	10.273716	10.054200	10.327916	58
3	9.672321	395	9.945733	112	9.726588	507.	10.273412	10.054267	10.327679	57
4	9.672558	395	9.945666	112	9.726892	507	10.273108	10.054334	10.327442	56
5	9.672795	394	9.945598	112	9.727197	507	10.272803	10.054402	10.327205	55
6	9.673032	394	9.945531	112	9.727501	507	10.272499	10.054469	10.326968	54
7	9.673268	394	9.945464	113	9.727805	506	10.272195	10.054536	10.326732	53
8	9.673505	394	9.945396	113	9.728109	506	10.271891	10.054604	10.326495	52
9	9.673741	393	9.945328	113	9.728412	506	10.271588	10.054672	10.326259	51
10	9.673977	393	9.945261	113	9.728716	506	10.271284	10.054739	10.326023	50
11	9.674213	393	9.945193	113	9.729020	506	10.270980	10.054807	10.325787	49
12	9.674448	392	9.945125	113	9.729323	505	10.270677	10.054875	10.325552	48
13	9.674684	392	9.945058	113	9.729626	505	10.270374	10.054942	10.325316	47
14	9.674919	392	9.944990	113	9.729929	505	10.270071	10.055010	10.325081	46
15	9.675155	392	9.944922	113	9.730233	505	10.269767	10.055078	10.324845	45
16	9.675390	391	9.944854	113	9.730535	505	10.269465	10.055146	10.324610	44
17	9.675624	391	9.944786	113	9.730838	504	10.269162	10.055214	10.324376	43
18	9.675859	391	9.944718	113	9.731141	504	10.268859	10.055282	10.324141	42
19	9.676094	391	9.944650	113	9.731444	504	10.268556	10.055350	10.323906	41
20	9.676328	390	9.944582	114	9.731746	504	10.268254	10.055418	10.323672	40
21	9.676562	390	9.944514	114	9.732048	504	10.267952	10.055486	10.323438	39
22	9.676796	390	9.944446	114	9.732351	503	10.267649	10.055554	10.323204	38
23	9.677030	390	9.944377	114	9.732653	503	10.267347	10.055623	10.322970	37
24	9.677264	389	9.944309	114	9.732955	503	10.267045	10.055691	10.322736	36
25	9.677498	389	9.944241	114	9.733257	503	10.266743	10.055759	10.322502	35
26	9.677731	389	9.944172	114	9.733558	503	10.266442	10.055828	10.322269	34
27	9.677964	388	9.944104	114	9.733860	503	10.266140	10.055896	10.322036	33
28	9.678197	388	9.944036	114	9.734162	502	10.265838	10.055964	10.321803	32
29	9.678430	388	9.943967	114	9.734463	502	10.265537	10.056033	10.321570	31
30	9.678663	388	9.943899	114	9.734764	502	10.265236	10.056101	10.321337	30
31	9.678895	387	9.943830	114	9.735066	502	10.264934	10.056170	10.321105	29
32	9.679128	387	9.943761	114	9.735367	502	10.264633	10.056239	10.320872	28
33	9.679360	387	9.943693	115	9.735668	501	10.264332	10.056307	10.320640	27
34	9.679592	387	9.943624	115	9.735969	501	10.264031	10.056376	10.320408	26
35	9.679824	386	9.943555	115	9.736269	501	10.263731	10.056445	10.320176	25
36	9.680056	386	9.943486	115	9.736570	501	10.263430	10.056514	10.319944	24
37	9.680288	386	9.943417	115	9.736871	501	10.263129	10.056583	10.319712	23
38	9.680519	385	9.943348	115	9.737171	500	10.262829	10.056652	10.319481	22
39	9.680750	385	9.943279	115	9.737471	500	10.262529	10.056721	10.319250	21
40	9.680982	385	9.943210	115	9.737771	500	10.262229	10.056790	10.319018	20
41	9.681213	385	9.943141	115	9.738071	500	10.261929	10.056859	10.318787	19
42	9.681443	384	9.943072	115	9.738371	500	10.261629	10.056928	10.318557	18
43	9.681674	384	9.943003	115	9.738671	500	10.261329	10.056997	10.318326	17
44	9.681905	384	9.942934	115	9.738971	499	10.261029	10.057066	10.318095	16
45	9.682135	384	9.942864	115	9.739271	499	10.260729	10.057136	10.317865	15
46	9.682365	383	9.942795	116	9.739570	499	10.260430	10.057205	10.317635	14
47	9.682595	383	9.942726	116	9.739870	499	10.260130	10.057274	10.317405	13
48	9.682825	383	9.942656	116	9.740169	499	10.259831	10.057344	10.317175	12
49	9.683055	383	9.942587	116	9.740468	498	10.259532	10.057413	10.316945	11
50	9.683284	382	9.942517	116	9.740767	498	10.259233	10.057483	10.316716	10
51	9.683514	382	9.942448	116	9.741066	498	10.258934	10.057552	10.316486	9
52	9.683743	382	9.942378	116	9.741365	498	10.258635	10.057622	10.316257	8
53	9.683972	382	9.942308	116	9.741664	498	10.258336	10.057692	10.316028	7
54	9.684201	381	9.942239	116	9.741962	498	10.258038	10.057761	10.315799	6
55	9.684430	381	9.942169	116	9.742261	497	10.257739	10.057831	10.315570	5
56	9.684658	381	9.942099	116	9.742559	497	10.257441	10.057901	10.315342	4
57	9.684887	380	9.942029	116	9.742858	497	10.257142	10.057971	10.315113	3
58	9.685115	380	9.941959	116	9.743156	497	10.256844	10.058041	10.314885	2
59	9.685343	380	9.941889	117	9.743454	497	10.256546	10.058111	10.314657	1
60	9.685571		9.941819		9.743752		10.256248	10.058181	10.314429	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

61 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

29 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.685571	380	9.941819	117	9.743752	496	10.256248	10.058181	10.314429	60
1	9.685799	379	9.941749	117	9.744050	496	10.255950	10.058251	10.314201	59
2	9.686027	379	9.941679	117	9.744348	496	10.255652	10.058321	10.313973	58
3	9.686254	379	9.941609	117	9.744645	496	10.255355	10.058391	10.313746	57
4	9.686482	379	9.941539	117	9.744943	496	10.255057	10.058461	10.313518	56
5	9.686709	378	9.941469	117	9.745240	496	10.254760	10.058531	10.313291	55
6	9.686936	378	9.941398	117	9.745538	495	10.254462	10.058602	10.313064	54
7	9.687163	378	9.941328	117	9.745835	495	10.254165	10.058672	10.312837	53
8	9.687389	378	9.941258	117	9.746132	495	10.253868	10.058742	10.312611	52
9	9.687616	377	9.941187	117	9.746429	495	10.253571	10.058813	10.312384	51
10	9.687843	377	9.941117	117	9.746726	495	10.253274	10.058883	10.312157	50
11	9.688069	377	9.941046	118	9.747023	494	10.252977	10.058954	10.311931	49
12	9.688295	377	9.940975	118	9.747319	494	10.252681	10.059025	10.311705	48
13	9.688521	376	9.940905	118	9.747616	494	10.252384	10.059095	10.311479	47
14	9.688747	376	9.940834	118	9.747913	494	10.252087	10.059166	10.311253	46
15	9.688972	376	9.940763	118	9.748209	494	10.251791	10.059237	10.311028	45
16	9.689198	376	9.940693	118	9.748505	494	10.251495	10.059307	10.310802	44
17	9.689423	375	9.940622	118	9.748801	493	10.251199	10.059378	10.310577	43
18	9.689648	375	9.940551	118	9.749097	493	10.250903	10.059449	10.310352	42
19	9.689873	375	9.940480	118	9.749393	493	10.250607	10.059520	10.310127	41
20	9.690098	375	9.940409	118	9.749689	493	10.250311	10.059591	10.309902	40
21	9.690323	374	9.940338	118	9.749985	493	10.250015	10.059662	10.309677	39
22	9.690548	374	9.940267	118	9.750281	493	10.249719	10.059733	10.309452	38
23	9.690772	374	9.940196	118	9.750576	492	10.249424	10.059804	10.309228	37
24	9.690996	374	9.940125	119	9.750872	492	10.249128	10.059875	10.309004	36
25	9.691220	373	9.940054	119	9.751167	492	10.248833	10.059946	10.308780	35
26	9.691444	373	9.939982	119	9.751462	492	10.248538	10.060018	10.308556	34
27	9.691668	373	9.939911	119	9.751757	492	10.248243	10.060089	10.308332	33
28	9.691892	373	9.939840	119	9.752052	491	10.247948	10.060160	10.308108	32
29	9.692115	372	9.939768	119	9.752347	491	10.247653	10.060232	10.307885	31
30	9.692339	372	9.939697	119	9.752642	491	10.247358	10.060303	10.307661	30
31	9.692562	372	9.939625	119	9.752937	491	10.247063	10.060375	10.307438	29
32	9.692785	371	9.939554	119	9.753231	491	10.246769	10.060446	10.307215	28
33	9.693008	371	9.939482	119	9.753526	491	10.246474	10.060518	10.306992	27
34	9.693231	371	9.939410	119	9.753820	490	10.246180	10.060590	10.306769	26
35	9.693453	371	9.939339	119	9.754115	490	10.245885	10.060661	10.306547	25
36	9.693676	370	9.939267	120	9.754409	490	10.245591	10.060733	10.306324	24
37	9.693898	370	9.939195	120	9.754703	490	10.245297	10.060805	10.306102	23
38	9.694120	370	9.939123	120	9.754997	490	10.245003	10.060877	10.305880	22
39	9.694342	370	9.939052	120	9.755291	490	10.244709	10.060948	10.305658	21
40	9.694564	369	9.938980	120	9.755585	489	10.244415	10.061020	10.305436	20
41	9.694786	369	9.938908	120	9.755878	489	10.244122	10.061092	10.305214	19
42	9.695007	369	9.938836	120	9.756172	489	10.243828	10.061164	10.304993	18
43	9.695229	369	9.938763	120	9.756465	489	10.243535	10.061237	10.304771	17
44	9.695450	368	9.938691	120	9.756759	489	10.243241	10.061309	10.304550	16
45	9.695671	368	9.938619	120	9.757052	489	10.242948	10.061381	10.304329	15
46	9.695892	368	9.938547	120	9.757345	488	10.242655	10.061453	10.304108	14
47	9.696113	368	9.938475	120	9.757638	488	10.242362	10.061525	10.303887	13
48	9.696334	367	9.938402	121	9.757931	488	10.242069	10.061598	10.303666	12
49	9.696554	367	9.938330	121	9.758224	488	10.241776	10.061670	10.303446	11
50	9.696775	367	9.938258	121	9.758517	488	10.241483	10.061742	10.303225	10
51	9.696995	367	9.938185	121	9.758810	488	10.241190	10.061815	10.303005	9
52	9.697215	366	9.938113	121	9.759102	487	10.240898	10.061887	10.302785	8
53	9.697435	366	9.938040	121	9.759395	487	10.240605	10.061960	10.302565	7
54	9.697654	366	9.937967	121	9.759687	487	10.240313	10.062033	10.302346	6
55	9.697874	366	9.937895	121	9.759979	487	10.240021	10.062105	10.302126	5
56	9.698094	365	9.937822	121	9.760272	487	10.239728	10.062178	10.301906	4
57	9.698313	365	9.937749	121	9.760564	487	10.239436	10.062251	10.301687	3
58	9.698532	365	9.937676	121	9.760856	486	10.239144	10.062324	10.301468	2
59	9.698751	365	9.937604	121	9.761148	486	10.238852	10.062396	10.301249	1
60	9.698970		9.937531		9.761439		10.238561	10.062469	10.301030	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

60 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

30 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.698970	364	9.937531	121	9.761439	486	10.238561	10.062469	10.301030	60
1	9.699189	364	9.937458	122	9.761731	486	10.238269	10.062542	10.300811	59
2	9.699407	364	9.937385	122	9.762023	486	10.237977	10.062615	10.300593	58
3	9.699626	364	9.937312	122	9.762314	486	10.237686	10.062688	10.300374	57
4	9.699844	363	9.937238	122	9.762606	485	10.237394	10.062762	10.300156	56
5	9.700062	363	9.937165	122	9.762897	485	10.237103	10.062835	10.299938	55
6	9.700280	363	9.937092	122	9.763188	485	10.236812	10.062908	10.299720	54
7	9.700498	363	9.937019	122	9.763479	485	10.236521	10.062981	10.299502	53
8	9.700716	363	9.936946	122	9.763770	485	10.236230	10.063054	10.299284	52
9	9.700933	362	9.936872	122	9.764061	485	10.235939	10.063128	10.299067	51
10	9.701151	362	9.936799	122	9.764352	485	10.235648	10.063201	10.298849	50
11	9.701368	362	9.936725	122	9.764643	484	10.235357	10.063275	10.298632	49
12	9.701585	362	9.936652	123	9.764933	484	10.235067	10.063348	10.298415	48
13	9.701802	361	9.936578	123	9.765224	484	10.234776	10.063422	10.298198	47
14	9.702019	361	9.936505	123	9.765514	484	10.234486	10.063495	10.297981	46
15	9.702236	361	9.936431	123	9.765805	484	10.234195	10.063569	10.297764	45
16	9.702452	361	9.936357	123	9.766095	484	10.233905	10.063643	10.297548	44
17	9.702669	360	9.936284	123	9.766385	483	10.233615	10.063716	10.297331	43
18	9.702885	360	9.936210	123	9.766675	483	10.233325	10.063790	10.297115	42
19	9.703101	360	9.936136	123	9.766965	483	10.233035	10.063864	10.296899	41
20	9.703317	360	9.936062	123	9.767255	483	10.232745	10.063938	10.296683	40
21	9.703533	359	9.935988	123	9.767545	483	10.232455	10.064012	10.296467	39
22	9.703749	359	9.935914	123	9.767834	483	10.232166	10.064086	10.296251	38
23	9.703964	359	9.935840	123	9.768124	482	10.231876	10.064160	10.296036	37
24	9.704179	359	9.935766	124	9.768414	482	10.231586	10.064234	10.295821	36
25	9.704395	359	9.935692	124	9.768703	482	10.231297	10.064308	10.295605	35
26	9.704610	358	9.935618	124	9.768992	482	10.231008	10.064382	10.295390	34
27	9.704825	358	9.935543	124	9.769281	482	10.230719	10.064457	10.295175	33
28	9.705040	358	9.935469	124	9.769570	482	10.230430	10.064531	10.294960	32
29	9.705254	358	9.935395	124	9.769860	481	10.230140	10.064605	10.294746	31
30	9.705469	357	9.935320	124	9.770148	481	10.229852	10.064680	10.294531	30
31	9.705683	357	9.935246	124	9.770437	481	10.229563	10.064754	10.294317	29
32	9.705898	357	9.935171	124	9.770726	481	10.229274	10.064829	10.294102	28
33	9.706112	357	9.935097	124	9.771015	481	10.228985	10.064903	10.293888	27
34	9.706326	356	9.935022	124	9.771303	481	10.228697	10.064978	10.293674	26
35	9.706539	356	9.934948	124	9.771592	481	10.228408	10.065052	10.293461	25
36	9.706753	356	9.934873	124	9.771880	480	10.228120	10.065127	10.293247	24
37	9.706967	356	9.934798	125	9.772168	480	10.227832	10.065202	10.293033	23
38	9.707180	355	9.934723	125	9.772457	480	10.227543	10.065277	10.292820	22
39	9.707393	355	9.934649	125	9.772745	480	10.227255	10.065351	10.292607	21
40	9.707606	355	9.934574	125	9.773033	480	10.226967	10.065426	10.292394	20
41	9.707819	355	9.934499	125	9.773321	480	10.226679	10.065501	10.292181	19
42	9.708032	354	9.934424	125	9.773608	480	10.226392	10.065576	10.291968	18
43	9.708245	354	9.934349	125	9.773896	479	10.226104	10.065651	10.291755	17
44	9.708458	354	9.934274	125	9.774184	479	10.225816	10.065726	10.291542	16
45	9.708670	354	9.934199	125	9.774471	479	10.225529	10.065801	10.291330	15
46	9.708882	353	9.934123	125	9.774759	479	10.225241	10.065877	10.291118	14
47	9.709094	353	9.934048	125	9.775046	479	10.224954	10.065952	10.290906	13
48	9.709306	353	9.933973	125	9.775333	479	10.224667	10.066027	10.290694	12
49	9.709518	353	9.933898	126	9.775621	478	10.224379	10.066102	10.290482	11
50	9.709730	353	9.933822	126	9.775908	478	10.224092	10.066178	10.290270	10
51	9.709941	352	9.933747	126	9.776195	478	10.223805	10.066253	10.290059	9
52	9.710153	352	9.933671	126	9.776482	478	10.223518	10.066329	10.289847	8
53	9.710364	352	9.933596	126	9.776769	478	10.223231	10.066404	10.289636	7
54	9.710575	352	9.933520	126	9.777055	478	10.222945	10.066480	10.289425	6
55	9.710786	351	9.933445	126	9.777342	478	10.222658	10.066555	10.289214	5
56	9.710997	351	9.933369	126	9.777628	477	10.222372	10.066631	10.289003	4
57	9.711208	351	9.933293	126	9.777915	477	10.222085	10.066707	10.288792	3
58	9.711419	351	9.933217	126	9.778201	477	10.221799	10.066783	10.288581	2
59	9.711629	350	9.933141	126	9.778487	477	10.221513	10.066859	10.288371	1
60	9.711839		9.933066		9.778774		10.221226	10.066934	10.288161	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

59 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

31 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.711839	350	9.933066	126	9.778774	477	10.221226	10.066934	10.288161	60
1	9.712050	350	9.932990	127	9.779060	477	10.220940	10.067010	10.287950	59
2	9.712260	350	9.932914	127	9.779346	477	10.220654	10.067086	10.287740	58
3	9.712469	349	9.932838	127	9.779632	476	10.220368	10.067162	10.287531	57
4	9.712679	349	9.932762	127	9.779918	476	10.220082	10.067238	10.287321	56
5	9.712889	349	9.932685	127	9.780203	476	10.219797	10.067315	10.287111	55
6	9.713098	349	9.932609	127	9.780489	476	10.219511	10.067391	10.286902	54
7	9.713308	349	9.932533	127	9.780775	476	10.219225	10.067467	10.286692	53
8	9.713517	348	9.932457	127	9.781060	476	10.218940	10.067543	10.286483	52
9	9.713726	348	9.932380	127	9.781346	476	10.218654	10.067620	10.286274	51
10	9.713935	348	9.932304	127	9.781631	475	10.218369	10.067696	10.286065	50
11	9.714144	348	9.932228	127	9.781916	475	10.218084	10.067772	10.285856	49
12	9.714352	347	9.932151	128	9.782201	475	10.217799	10.067849	10.285648	48
13	9.714561	347	9.932075	128	9.782486	475	10.217514	10.067925	10.285439	47
14	9.714769	347	9.931998	128	9.782771	475	10.217229	10.068002	10.285231	46
15	9.714978	347	9.931921	128	9.783056	475	10.216944	10.068079	10.285022	45
16	9.715186	347	9.931845	128	9.783341	475	10.216659	10.068155	10.284814	44
17	9.715394	346	9.931768	128	9.783626	474	10.216374	10.068232	10.284606	43
18	9.715602	346	9.931691	128	9.783910	474	10.216090	10.068309	10.284398	42
19	9.715809	346	9.931614	128	9.784195	474	10.215805	10.068386	10.284191	41
20	9.716017	346	9.931537	128	9.784479	474	10.215521	10.068463	10.283983	40
21	9.716224	345	9.931460	128	9.784764	474	10.215236	10.068540	10.283776	39
22	9.716432	345	9.931383	128	9.785048	474	10.214952	10.068617	10.283568	38
23	9.716639	345	9.931306	128	9.785332	474	10.214668	10.068694	10.283361	37
24	9.716846	345	9.931229	129	9.785616	473	10.214384	10.068771	10.283154	36
25	9.717053	345	9.931152	129	9.785900	473	10.214100	10.068848	10.282947	35
26	9.717259	344	9.931075	129	9.786184	473	10.213816	10.068925	10.282741	34
27	9.717466	344	9.930998	129	9.786468	473	10.213532	10.069002	10.282534	33
28	9.717673	344	9.930921	129	9.786752	473	10.213248	10.069079	10.282327	32
29	9.717879	344	9.930843	129	9.787036	473	10.212964	10.069157	10.282121	31
30	9.718085	343	9.930766	129	9.787319	473	10.212681	10.069234	10.281915	30
31	9.718291	343	9.930688	129	9.787603	472	10.212397	10.069312	10.281709	29
32	9.718497	343	9.930611	129	9.787886	472	10.212114	10.069389	10.281503	28
33	9.718703	343	9.930533	129	9.788170	472	10.211830	10.069467	10.281297	27
34	9.718909	343	9.930456	129	9.788453	472	10.211547	10.069544	10.281091	26
35	9.719114	342	9.930378	129	9.788736	472	10.211264	10.069622	10.280886	25
36	9.719320	342	9.930300	130	9.789019	472	10.210981	10.069700	10.280680	24
37	9.719525	342	9.930223	130	9.789302	472	10.210698	10.069777	10.280475	23
38	9.719730	342	9.930145	130	9.789585	471	10.210415	10.069855	10.280270	22
39	9.719935	341	9.930067	130	9.789868	471	10.210132	10.069933	10.280065	21
40	9.720140	341	9.929989	130	9.790151	471	10.209849	10.070011	10.279860	20
41	9.720345	341	9.929911	130	9.790433	471	10.209567	10.070089	10.279655	19
42	9.720549	341	9.929833	130	9.790716	471	10.209284	10.070167	10.279451	18
43	9.720754	340	9.929755	130	9.790999	471	10.209001	10.070245	10.279246	17
44	9.720958	340	9.929677	130	9.791281	471	10.208719	10.070323	10.279042	16
45	9.721162	340	9.929599	130	9.791563	470	10.208437	10.070401	10.278838	15
46	9.721366	340	9.929521	130	9.791846	470	10.208154	10.070479	10.278634	14
47	9.721570	340	9.929442	130	9.792128	470	10.207872	10.070558	10.278430	13
48	9.721774	339	9.929364	131	9.792410	470	10.207590	10.070636	10.278226	12
49	9.721978	339	9.929286	131	9.792692	470	10.207308	10.070714	10.278022	11
50	9.722181	339	9.929207	131	9.792974	470	10.207026	10.070793	10.277819	10
51	9.722385	339	9.929129	131	9.793256	470	10.206744	10.070871	10.277615	9
52	9.722588	339	9.929050	131	9.793538	469	10.206462	10.070950	10.277412	8
53	9.722791	338	9.928972	131	9.793819	469	10.206181	10.071028	10.277209	7
54	9.722994	338	9.928893	131	9.794101	469	10.205899	10.071107	10.277006	6
55	9.723197	338	9.928815	131	9.794383	469	10.205617	10.071185	10.276803	5
56	9.723400	338	9.928736	131	9.794664	469	10.205336	10.071264	10.276600	4
57	9.723603	337	9.928657	131	9.794945	469	10.205055	10.071343	10.276397	3
58	9.723805	337	9.928578	131	9.795227	469	10.204773	10.071422	10.276195	2
59	9.724007	337	9.928499	131	9.795508	468	10.204492	10.071501	10.275993	1
60	9.724210		9.928420		9.795789		10.204211	10.071580	10.275790	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

58 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

32 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.724210	337	9.928420	132	9.795789	468	10.204211	10.071580	10.275790	60
1	9.724412	337	9.928342	132	9.796070	468	10.203930	10.071658	10.275588	59
2	9.724614	336	9.928263	132	9.796351	468	10.203649	10.071737	10.275386	58
3	9.724816	336	9.928183	132	9.796632	468	10.203368	10.071817	10.275184	57
4	9.725017	336	9.928104	132	9.796913	468	10.203087	10.071896	10.274983	56
5	9.725219	336	9.928025	132	9.797194	468	10.202806	10.071975	10.274781	55
6	9.725420	335	9.927946	132	9.797475	468	10.202525	10.072054	10.274580	54
7	9.725622	335	9.927867	132	9.797755	467	10.202245	10.072133	10.274378	53
8	9.725823	335	9.927787	132	9.798036	467	10.201964	10.072213	10.274177	52
9	9.726024	335	9.927708	132	9.798316	467	10.201684	10.072292	10.273976	51
10	9.726225	335	9.927629	132	9.798596	467	10.201404	10.072371	10.273775	50
11	9.726426	334	9.927549	132	9.798877	467	10.201123	10.072451	10.273574	49
12	9.726626	334	9.927470	133	9.799157	467	10.200843	10.072530	10.273374	48
13	9.726827	334	9.927390	133	9.799437	467	10.200563	10.072610	10.273173	47
14	9.727027	334	9.927310	133	9.799717	467	10.200283	10.072690	10.272973	46
15	9.727228	334	9.927231	133	9.799997	466	10.200003	10.072769	10.272772	45
16	9.727428	333	9.927151	133	9.800277	466	10.199723	10.072849	10.272572	44
17	9.727628	333	9.927071	133	9.800557	466	10.199443	10.072929	10.272372	43
18	9.727828	333	9.926991	133	9.800836	466	10.199164	10.073009	10.272172	42
19	9.728027	333	9.926911	133	9.801116	466	10.198884	10.073089	10.271973	41
20	9.728227	333	9.926831	133	9.801396	466	10.198604	10.073169	10.271773	40
21	9.728427	332	9.926751	133	9.801675	466	10.198325	10.073249	10.271573	39
22	9.728626	332	9.926671	133	9.801955	466	10.198045	10.073329	10.271374	38
23	9.728825	332	9.926591	133	9.802234	465	10.197766	10.073409	10.271175	37
24	9.729024	332	9.926511	134	9.802513	465	10.197487	10.073489	10.270976	36
25	9.729223	331	9.926431	134	9.802792	465	10.197208	10.073569	10.270777	35
26	9.729422	331	9.926351	134	9.803072	465	10.196928	10.073649	10.270578	34
27	9.729621	331	9.926270	134	9.803351	465	10.196649	10.073730	10.270379	33
28	9.729820	331	9.926190	134	9.803630	465	10.196370	10.073810	10.270180	32
29	9.730018	330	9.926110	134	9.803908	465	10.196092	10.073890	10.269982	31
30	9.730217	330	9.926029	134	9.804187	465	10.195813	10.073971	10.269783	30
31	9.730415	330	9.925949	134	9.804466	464	10.195534	10.074051	10.269585	29
32	9.730613	330	9.925868	134	9.804745	464	10.195255	10.074132	10.269387	28
33	9.730811	330	9.925788	134	9.805023	464	10.194977	10.074212	10.269189	27
34	9.731009	329	9.925707	134	9.805302	464	10.194698	10.074293	10.268991	26
35	9.731206	329	9.925626	134	9.805580	464	10.194420	10.074374	10.268794	25
36	9.731404	329	9.925545	135	9.805859	464	10.194141	10.074455	10.268596	24
37	9.731602	329	9.925465	135	9.806137	464	10.193863	10.074535	10.268398	23
38	9.731799	329	9.925384	135	9.806415	464	10.193585	10.074616	10.268201	22
39	9.731996	328	9.925303	135	9.806693	463	10.193307	10.074697	10.268004	21
40	9.732193	328	9.925222	135	9.806971	463	10.193029	10.074778	10.267807	20
41	9.732390	328	9.925141	135	9.807249	463	10.192751	10.074859	10.267610	19
42	9.732587	328	9.925060	135	9.807527	463	10.192473	10.074940	10.267413	18
43	9.732784	328	9.924979	135	9.807805	463	10.192195	10.075021	10.267216	17
44	9.732980	327	9.924897	135	9.808083	463	10.191917	10.075103	10.267020	16
45	9.733177	327	9.924816	135	9.808361	463	10.191639	10.075184	10.266823	15
46	9.733373	327	9.924735	136	9.808638	463	10.191362	10.075265	10.266627	14
47	9.733569	327	9.924654	136	9.808916	462	10.191084	10.075346	10.266431	13
48	9.733765	327	9.924572	136	9.809193	462	10.190807	10.075428	10.266235	12
49	9.733961	326	9.924491	136	9.809471	462	10.190529	10.075509	10.266039	11
50	9.734157	326	9.924409	136	9.809748	462	10.190252	10.075591	10.265843	10
51	9.734353	326	9.924328	136	9.810025	462	10.189975	10.075672	10.265647	9
52	9.734549	326	9.924246	136	9.810302	462	10.189698	10.075754	10.265451	8
53	9.734744	325	9.924164	136	9.810580	462	10.189420	10.075836	10.265256	7
54	9.734939	325	9.924083	136	9.810857	462	10.189143	10.075917	10.265061	6
55	9.735135	325	9.924001	136	9.811134	461	10.188866	10.075999	10.264865	5
56	9.735330	325	9.923919	136	9.811410	461	10.188590	10.076081	10.264670	4
57	9.735525	325	9.923837	136	9.811687	461	10.188313	10.076163	10.264475	3
58	9.735719	324	9.923755	137	9.811964	461	10.188036	10.076245	10.264281	2
59	9.735914	324	9.923673	137	9.812241	461	10.187759	10.076327	10.264086	1
60	9.736109		9.923591		9.812517		10.187483	10.076409	10.263891	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

57 Degrees.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

33 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Taug.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.736109	324	9.923591	137	9.812517	461	10.187483	10.076409	10.263891	60
1	9.736303	324	9.923509	137	9.812794	461	10.187206	10.076491	10.263697	59
2	9.736498	324	9.923427	137	9.813070	461	10.186930	10.076573	10.263502	58
3	9.736692	323	9.923345	137	9.813347	460	10.186653	10.076655	10.263308	57
4	9.736886	323	9.923263	137	9.813623	460	10.186377	10.076737	10.263114	56
5	9.737080	323	9.923181	137	9.813899	460	10.186101	10.076819	10.262920	55
6	9.737274	323	9.923098	137	9.814175	460	10.185825	10.076902	10.262726	54
7	9.737467	323	9.923016	137	9.814452	460	10.185548	10.076984	10.262533	53
8	9.737661	322	9.922933	137	9.814728	460	10.185272	10.077067	10.262339	52
9	9.737855	322	9.922851	137	9.815004	460	10.184996	10.077149	10.262145	51
10	9.738048	322	9.922768	138	9.815279	460	10.184721	10.077232	10.261952	50
11	9.738241	322	9.922686	138	9.815555	460	10.184445	10.077314	10.261759	49
12	9.738434	322	9.922603	138	9.815831	459	10.184169	10.077397	10.261566	48
13	9.738627	321	9.922520	138	9.816107	459	10.183893	10.077480	10.261373	47
14	9.738820	321	9.922438	138	9.816382	459	10.183618	10.077562	10.261180	46
15	9.739013	321	9.922355	138	9.816658	459	10.183342	10.077645	10.260987	45
16	9.739206	321	9.922272	138	9.816933	459	10.183067	10.077728	10.260794	44
17	9.739398	321	9.922189	138	9.817209	459	10.182791	10.077811	10.260602	43
18	9.739590	320	9.922106	138	9.817484	459	10.182516	10.077894	10.260410	42
19	9.739783	320	9.922023	138	9.817759	459	10.182241	10.077977	10.260217	41
20	9.739975	320	9.921940	138	9.818035	459	10.181965	10.078060	10.260025	40
21	9.740167	320	9.921857	139	9.818310	458	10.181690	10.078143	10.259833	39
22	9.740359	320	9.921774	139	9.818585	458	10.181415	10.078226	10.259641	38
23	9.740550	319	9.921691	139	9.818860	458	10.181140	10.078309	10.259450	37
24	9.740742	319	9.921607	139	9.819135	458	10.180865	10.078393	10.259258	36
25	9.740934	319	9.921524	139	9.819410	458	10.180590	10.078476	10.259066	35
26	9.741125	319	9.921441	139	9.819684	458	10.180316	10.078559	10.258875	34
27	9.741316	319	9.921357	139	9.819959	458	10.180041	10.078643	10.258684	33
28	9.741508	318	9.921274	139	9.820234	458	10.179766	10.078726	10.258492	32
29	9.741699	318	9.921190	139	9.820508	458	10.179492	10.078810	10.258301	31
30	9.741889	318	9.921107	139	9.820783	457	10.179217	10.078893	10.258111	30
31	9.742080	318	9.921023	139	9.821057	457	10.178943	10.078977	10.257920	29
32	9.742271	318	9.920939	139	9.821332	457	10.178668	10.079061	10.257729	28
33	9.742462	317	9.920856	140	9.821606	457	10.178394	10.079144	10.257538	27
34	9.742652	317	9.920772	140	9.821880	457	10.178120	10.079228	10.257348	26
35	9.742842	317	9.920688	140	9.822154	457	10.177846	10.079312	10.257158	25
36	9.743033	317	9.920604	140	9.822429	457	10.177571	10.079396	10.256967	24
37	9.743223	317	9.920520	140	9.822703	457	10.177297	10.079480	10.256777	23
38	9.743413	316	9.920436	140	9.822977	457	10.177023	10.079564	10.256587	22
39	9.743602	316	9.920352	140	9.823250	456	10.176750	10.079648	10.256398	21
40	9.743792	316	9.920268	140	9.823524	456	10.176476	10.079732	10.256208	20
41	9.743982	316	9.920184	140	9.823798	456	10.176202	10.079816	10.256018	19
42	9.744171	316	9.920099	140	9.824072	456	10.175928	10.079901	10.255829	18
43	9.744361	315	9.920015	140	9.824345	456	10.175655	10.079985	10.255639	17
44	9.744550	315	9.919931	141	9.824619	456	10.175381	10.080069	10.255450	16
45	9.744739	315	9.919846	141	9.824893	456	10.175107	10.080154	10.255261	15
46	9.744928	315	9.919762	141	9.825166	456	10.174834	10.080238	10.255072	14
47	9.745117	315	9.919677	141	9.825439	456	10.174561	10.080323	10.254883	13
48	9.745306	314	9.919593	141	9.825713	455	10.174287	10.080407	10.254694	12
49	9.745494	314	9.919508	141	9.825986	455	10.174014	10.080492	10.254506	11
50	9.745683	314	9.919424	141	9.826259	455	10.173741	10.080576	10.254317	10
51	9.745871	314	9.919339	141	9.826532	455	10.173468	10.080661	10.254129	9
52	9.746060	314	9.919254	141	9.826805	455	10.173195	10.080746	10.253940	8
53	9.746248	313	9.919169	141	9.827078	455	10.172922	10.080831	10.253752	7
54	9.746436	313	9.919085	141	9.827351	455	10.172649	10.080915	10.253564	6
55	9.746624	313	9.919000	142	9.827624	455	10.172376	10.081000	10.253376	5
56	9.746812	313	9.918915	142	9.827897	455	10.172103	10.081085	10.253188	4
57	9.746999	313	9.918830	142	9.828170	454	10.171830	10.081170	10.253001	3
58	9.747187	312	9.918745	142	9.828442	454	10.171558	10.081255	10.252813	2
59	9.747374	312	9.918659	142	9.828715	454	10.171285	10.081341	10.252626	1
60	9.747562		9.918574		9.828987		10.171013	10.081426	10.252438	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

56 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

34 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.747562	312	9.918574	142	9.828987	454	10.171013	10.081426	10.252438	60
1	9.747749	312	9.918489	142	9.829260	454	10.170740	10.081511	10.252251	59
2	9.747936	312	9.918404	142	9.829532	454	10.170468	10.081596	10.252064	58
3	9.748123	311	9.918318	142	9.829805	454	10.170195	10.081682	10.251877	57
4	9.748310	311	9.918233	142	9.830077	454	10.169923	10.081767	10.251690	56
5	9.748497	311	9.918147	142	9.830349	454	10.169651	10.081853	10.251503	55
6	9.748683	311	9.918062	143	9.830621	453	10.169379	10.081938	10.251317	54
7	9.748870	311	9.917976	143	9.830893	453	10.169107	10.082024	10.251130	53
8	9.749056	310	9.917891	143	9.831165	453	10.168835	10.082109	10.250944	52
9	9.749243	310	9.917805	143	9.831437	453	10.168563	10.082195	10.250757	51
10	9.749429	310	9.917719	143	9.831709	453	10.168291	10.082281	10.250571	50
11	9.749615	310	9.917634	143	9.831981	453	10.168019	10.082366	10.250385	49
12	9.749801	310	9.917548	143	9.832253	453	10.167747	10.082452	10.250199	48
13	9.749987	309	9.917462	143	9.832525	453	10.167475	10.082538	10.250013	47
14	9.750172	309	9.917376	143	9.832796	453	10.167204	10.082624	10.249828	46
15	9.750358	309	9.917290	143	9.833068	453	10.166932	10.082710	10.249642	45
16	9.750543	309	9.917204	143	9.833339	452	10.166661	10.082796	10.249457	44
17	9.750729	309	9.917118	144	9.833611	452	10.166389	10.082882	10.249271	43
18	9.750914	308	9.917032	144	9.833882	452	10.166118	10.082968	10.249086	42
19	9.751099	308	9.916946	144	9.834154	452	10.165846	10.083054	10.248901	41
20	9.751284	308	9.916859	144	9.834425	452	10.165575	10.083141	10.248716	40
21	9.751469	308	9.916773	144	9.834696	452	10.165304	10.083227	10.248531	39
22	9.751654	308	9.916687	144	9.834967	452	10.165033	10.083313	10.248346	38
23	9.751839	308	9.916600	144	9.835238	452	10.164762	10.083400	10.248161	67
24	9.752023	307	9.916514	144	9.835509	452	10.164491	10.083486	10.247977	36
25	9.752208	307	9.916427	144	9.835780	452	10.164220	10.083573	10.247792	35
26	9.752392	307	9.916341	144	9.836051	451	10.163949	10.083659	10.247608	34
27	9.752576	307	9.916254	144	9.836322	451	10.163678	10.083746	10.247424	33
28	9.752760	307	9.916167	145	9.836593	451	10.163407	10.083833	10.247240	32
29	9.752944	306	9.916081	145	9.836864	451	10.163136	10.083919	10.247056	31
30	9.753128	306	9.915994	145	9.837134	451	10.162866	10.084006	10.246872	30
31	9.753312	306	9.915907	145	9.837405	451	10.162595	10.084093	10.246688	29
32	9.753495	306	9.915820	145	9.837675	451	10.162325	10.084180	10.246505	28
33	9.753679	306	9.915733	145	9.837946	451	10.162054	10.084267	10.246321	27
34	9.753862	305	9.915646	145	9.838216	451	10.161784	10.084354	10.246138	26
35	9.754046	305	9.915559	145	9.838487	451	10.161513	10.084441	10.245954	25
36	9.754229	305	9.915472	145	9.838757	450	10.161243	10.084528	10.245771	24
37	9.754412	305	9.915385	145	9.839027	450	10.160973	10.084615	10.245588	23
38	9.754595	305	9.915297	145	9.839297	450	10.160703	10.084703	10.245405	22
39	9.754778	304	9.915210	145	9.839568	450	10.160432	10.084790	10.245222	21
40	9.754960	304	9.915123	146	9.839838	450	10.160162	10.084877	10.245040	20
41	9.755143	304	9.915035	146	9.840108	450	10.159892	10.084965	10.244857	19
42	9.755326	304	9.914948	146	9.840378	450	10.159622	10.085052	10.244674	18
43	9.755508	304	9.914860	146	9.840647	450	10.159353	10.085140	10.244492	17
44	9.755690	304	9.914773	146	9.840917	450	10.159083	10.085227	10.244310	16
45	9.755872	303	9.914685	146	9.841187	450	10.158813	10.085315	10.244128	15
46	9.756054	303	9.914598	146	9.841457	449	10.158543	10.085402	10.243946	14
47	9.756236	303	9.914510	146	9.841726	449	10.158274	10.085490	10.243764	13
48	9.756418	303	9.914422	146	9.841996	449	10.158004	10.085578	10.243582	12
49	9.756600	303	9.914334	146	9.842266	449	10.157734	10.085666	10.243400	11
50	9.756782	302	9.914246	147	9.842535	449	10.157465	10.085754	10.243218	10
51	9.756963	302	9.914158	147	9.842805	449	10.157195	10.085842	10.243037	9
52	9.757144	302	9.914070	147	9.843074	449	10.156926	10.085930	10.242856	8
53	9.757326	302	9.913982	147	9.843343	449	10.156657	10.086018	10.242674	7
54	9.757507	302	9.913894	147	9.843612	449	10.156388	10.086106	10.242493	6
55	9.757688	301	9.913806	147	9.843882	449	10.156118	10.086194	10.242312	5
56	9.757869	301	9.913718	147	9.844151	448	10.155849	10.086282	10.242131	4
57	9.758050	301	9.913630	147	9.844420	448	10.155580	10.086370	10.241950	3
58	9.758230	301	9.913541	147	9.844689	448	10.155311	10.086459	10.241770	2
59	9.758411	301	9.913453	147	9.844958	448	10.155042	10.086547	10.241589	1
60	9.758591		9.913365		9.845227		10.154773	10.086635	10.241409	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

55 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

35 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.758591	301	9.913365	147	9.845227	448	10.154773	10.086635	10.241409	60
1	9.758772	300	9.913276	147	9.845496	448	10.154504	10.086724	10.241228	59
2	9.758952	300	9.913187	148	9.845764	448	10.154236	10.086813	10.241048	58
3	9.759132	300	9.913099	148	9.846033	448	10.153967	10.086901	10.240868	57
4	9 759312	300	9.913010	148	9.846302	448	10.153698	10.086990	10.240688	56
5	9.759492	300	9.912922	148	9.846570	448	10.153430	10.087078	10.240508	55
6	9.759672	299	9.912833	148	9.846839	448	10.153161	10.087167	10.240328	54
7	9.759852	299	9.912744	148	9.847107	447	10.152893	10.087256	10.240148	53
8	9.760031	299	9.912655	148	9.847376	447	10.152624	10.087345	10.239969	52
9	9.760211	299	9.912566	148	9.847644	447	10.152356	10.087434	10.239789	51
10	9.760390	299	9.912477	148	9.847913	447	10.152087	10.087523	10.239610	50
11	9.760569	298	9.912388	148	9.848181	447	10.151819	10.087612	10.239431	49
12	9.760748	298	9.912299	149	9.848449	447	10.151551	10.087701	10.239252	48
13	9.760927	298	9.912210	149	9.848717	447	10.151283	10.087790	10.239073	47
14	9.761106	298	9.912121	149	9.848986	447	10.151014	10.087879	10.238894	46
15	9.761285	298	9.912031	149	9.849254	447	10.150746	10.087969	10.238715	45
16	9.761464	298	9.911942	149	9.849522	447	10.150478	10.088058	10.238536	44
17	9.761642	297	9.911853	149	9.849790	446	10.150210	10.088147	10.238358	43
18	9.761821	297	9.911763	149	9.850058	446	10.149942	10.088237	10.238179	42
19	9.761999	297	9.911674	149	9.850325	446	10.149675	10.088326	10.238001	41
20	9.762177	297	9.911584	149	9.850593	446	10.149407	10.088416	10.237823	40
21	9.762356	297	9.911495	149	9.850861	446	10.149139	10.088505	10.237644	39
22	9.762534	296	9.911405	149	9.851129	446	10.148871	10.088595	10.237466	38
23	9.762712	296	9.911315	150	9.851396	446	10.148604	10.088685	10.237288	37
24	9.762889	296	9.911226	150	9.851664	446	10.148336	10.088774	10.237111	36
25	9.763067	296	9.911136	150	9.851931	446	10.148069	10.088864	10.236933	35
26	9.763245	296	9.911046	150	9.852199	446	10.147801	10.088954	10.236755	34
27	9.763422	296	9.910956	150	9.852466	446	10.147534	10.089044	10.236578	33
28	9.763600	295	9.910866	150	9.852733	445	10.147267	10.089134	10.236400	32
29	9.763777	295	9.910776	150	9.853001	445	10.146999	10.089224	10.236223	31
30	9.763954	295	9.910686	150	9.853268	445	10.146732	10.089314	10.236016	30
31	9.764131	295	9.910596	150	9.853535	445	10.146465	10.089404	10.235869	29
32	9.764308	295	9.910506	150	9.853802	445	10.146198	10.089494	10.235692	28
33	9.764485	294	9.910415	150	9.854069	445	10.145931	10.089585	10.235515	27
34	9.764662	294	9.910325	151	9.854336	445	10.145664	10.089675	10.235338	26
35	9.764838	294	9.910235	151	9.854603	445	10.145397	10.089765	10.235162	25
36	9.765015	294	9.910144	151	9.854870	445	10.145130	10.089856	10.234985	24
37	9.765191	294	9.910054	151	9.855137	445	10.144863	10.089946	10.234809	23
38	9.765367	294	9.909963	151	9.855404	445	10.144596	10.090037	10.234633	22
39	9.765544	293	9.909873	151	9.855671	444	10.144329	10.090127	10.234456	21
40	9.765720	293	9.909782	151	9.855938	444	10.144062	10.090218	10.234280	20
41	9.765896	293	9.909691	151	9.856204	444	10.143796	10.090309	10.234104	19
42	9.766072	293	9.909601	151	9.856471	444	10.143529	10.090399	10.233928	18
43	9.766247	293	9.909510	151	9.856737	444	10.143263	10.090490	10.233753	17
44	9.766423	293	9.909419	151	9.857004	444	10.142996	10.090581	10.233577	16
45	9.766598	292	9.909328	152	9.857270	444	10.142730	10.090672	10.233402	15
46	9.766774	292	9.909237	152	9.857537	444	10.142463	10.090763	10.233226	14
47	9.766949	292	9.909146	152	9.857803	444	10.142197	10.090854	10.233051	13
48	9.767124	292	9.909055	152	9.858069	444	10.141931	10.090945	10.232876	12
49	9.767300	292	9.908964	152	9.858336	444	10.141664	10.091036	10.232700	11
50	9.767475	291	9.908873	152	9.858602	444	10.141398	10.091127	10.232525	10
51	9.767649	291	9.908781	152	9.858868	443	10.141132	10.091219	10.232351	9
52	9.767824	291	9.908690	152	9.859134	443	10.140866	10.091310	10.232176	8
53	9.767999	291	9.908599	152	9.859400	443	10.140600	10.091401	10.232001	7
54	9.768173	291	9.908507	152	9.859666	443	10.140334	10.091493	10.231827	6
55	9.768348	290	9.908416	153	9.859932	443	10.140068	10.091584	10.231652	5
56	9.768522	290	9.908324	153	9.860198	443	10.139802	10.091676	10.231478	4
57	9.768697	290	9.908233	153	9.860464	443	10.139536	10.091767	10.231303	3
58	9.768871	290	9.908141	153	9.860730	443	10.139270	10.091859	10.231129	2
59	9.769045	290	9.908049	153	9.860995	443	10.139005	10.091951	10.230955	1
60	9.769219		9.907958		9.861261		10.138739	10.092042	10.230781	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

54 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

36 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.769219	290	9.907958	153	9.861261	443	10.138739	10.092042	10.230781	60
1	9.769393	289	9.907866	153	9.861527	443	10.138473	10.092134	10.230607	59
2	9.769566	289	9.907774	153	9.861792	443	10.138208	10.092226	10.230434	58
3	9.769740	289	9.907682	153	9.862058	442	10.137942	10.092318	10.230260	57
4	9.769913	289	9.907590	153	9.862323	442	10.137677	10.092410	10.230087	56
5	9.770087	289	9.907498	153	9.862589	442	10.137411	10.092502	10.229913	55
6	9.770260	288	9.907406	153	9.862854	442	10.137146	10.092594	10.229740	54
7	9.770433	288	9.907314	154	9.863119	442	10.136881	10.092686	10.229567	53
8	9.770606	288	9.907222	154	9.863385	442	10.136615	10.092778	10.229394	52
9	9.770779	288	9.907129	154	9.863650	442	10.136350	10.092871	10.229221	51
10	9.770952	288	9.907037	154	9.863915	442	10.136085	10.092963	10.229048	50
11	9.771125	288	9.906945	154	9.864180	442	10.135820	10.093055	10.228875	49
12	9.771298	287	9.906852	154	9.864445	442	10.135555	10.093148	10.228702	48
13	9.771470	287	9.906760	154	9.864710	442	10.135290	10.093240	10.228530	47
14	9.771643	287	9.906667	154	9.864975	442	10.135025	10.093333	10.228357	46
15	9.771815	287	9.906575	154	9.865240	441	10.134760	10.093425	10.228185	45
16	9.771987	287	9.906482	154	9.865505	441	10.134495	10.093518	10.228013	44
17	9.772159	287	9.906389	155	9.865770	441	10.134230	10.093611	10.227841	43
18	9.772331	286	9.906296	155	9.866035	441	10.133965	10.093704	10.227669	42
19	9.772503	286	9.906204	155	9.866300	441	10.133700	10.093796	10.227497	41
20	9.772675	286	9.906111	155	9.866564	441	10.133436	10.093889	10.227325	40
21	9.772847	286	9.906018	155	9.866829	441	10.133171	10.093982	10.227153	39
22	9.773018	286	9.905925	155	9.867094	441	10.132906	10.094075	10.226982	38
23	9.773190	286	9.905832	155	9.867358	441	10.132642	10.094168	10.226810	37
24	9.773361	285	9.905739	155	9.867623	441	10.132377	10.094261	10.226639	36
25	9.773533	285	9.905645	155	9.867887	441	10.132113	10.094355	10.226467	35
26	9.773704	285	9.905552	155	9.868152	441	10.131848	10.094448	10.226296	34
27	9.773875	285	9.905459	155	9.868416	441	10.131584	10.094541	10.226125	33
28	9.774046	285	9.905366	156	9.868680	440	10.131320	10.094634	10.225954	32
29	9.774217	285	9.905272	156	9.868945	440	10.131055	10.094728	10.225783	31
30	9.774388	284	9.905179	156	9.869209	440	10.130791	10.094821	10.225612	30
31	9.774558	284	9.905085	156	9.869473	440	10.130527	10.094915	10.225442	29
32	9.774729	284	9.904992	156	9.869737	440	10.130263	10.095008	10.225271	28
33	9.774899	284	9.904898	156	9.870001	440	10.129999	10.095102	10.225101	27
34	9.775070	284	9.904804	156	9.870265	440	10.129735	10.095196	10.224930	26
35	9.775240	284	9.904711	156	9.870529	440	10.129471	10.095289	10.224760	25
36	9.775410	283	9.904617	156	9.870793	440	10.129207	10.095383	10.224590	24
37	9.775580	283	9.904523	156	9.871057	440	10.128943	10.095477	10.224420	23
38	9.775750	283	9.904429	157	9.871321	440	10.128679	10.095571	10.224250	22
39	9.775920	283	9.904335	157	9.871585	440	10.128415	10.095665	10.224080	21
40	9.776090	283	9.904241	157	9.871849	440	10.128151	10.095759	10.223910	20
41	9.776259	283	9.904147	157	9.872112	439	10.127888	10.095853	10.223741	19
42	9.776429	282	9.904053	157	9.872376	439	10.127624	10.095947	10.223571	18
43	9.776598	282	9.903959	157	9.872640	439	10.127360	10.096041	10.223402	17
44	9.776768	282	9.903864	157	9.872903	439	10.127097	10.096136	10.223232	16
45	9.776937	282	9.903770	157	9.873167	439	10.126833	10.096230	10.223063	15
46	9.777106	282	9.903676	157	9.873430	439	10.126570	10.096324	10.222894	14
47	9.777275	281	9.903581	157	9.873694	439	10.126306	10.096419	10.222725	13
48	9.777444	281	9.903487	157	9.873957	439	10.126043	10.096513	10.222556	12
49	9.777613	281	9.903392	158	9.874220	439	10.125780	10.096608	10.222387	11
50	9.777781	281	9.903298	158	9.874484	439	10.125516	10.096702	10.222219	10
51	9.777950	281	9.903203	158	9.874747	439	10.125253	10.096797	10.222050	9
52	9.778119	281	9.903108	158	9.875010	439	10.124990	10.096892	10.221881	8
53	9.778287	280	9.903014	158	9.875273	439	10.124727	10.096986	10.221713	7
54	9.778455	280	9.902919	158	9.875536	439	10.124464	10.097081	10.221545	6
55	9.778624	280	9.902824	158	9.875800	438	10.124200	10.097176	10.221376	5
56	9.778792	280	9.902729	158	9.876063	438	10.123937	10.097271	10.221208	4
57	9.778960	280	9.902634	158	9.876326	438	10.123674	10.097366	10.221040	3
58	9.779128	280	9.902539	159	9.876589	438	10.123411	10.097461	10.220872	2
59	9.779295	279	9.902444	159	9.876851	438	10.123149	10.097556	10.220705	1
60	9.779463		9.902349		9.877114		10.122886	10.097651	10.220537	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

53 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

37 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.779463	279	9.902349	159	9.877114	438	10.122886	10.097651	10.220537	60
1	9.779631	279	9.902253	159	9.877377	438	10.122623	10.097747	10.220369	59
2	9.779798	279	9.902158	159	9.877640	438	10.122360	10.097842	10.220202	58
3	9.779966	279	9.902063	159	9.877903	438	10.122097	10.097937	10.220034	57
4	9.780133	279	9.901967	159	9.878165	438	10.121835	10.098033	10.219867	56
5	9.780300	278	9.901872	159	9.878428	438	10.121572	10.098128	10.219700	55
6	9.780467	278	9.901776	159	9.878691	438	10.121309	10.098224	10.219533	54
7	9.780634	278	9.901681	159	9.878953	437	10.121047	10.098319	10.219366	53
8	9.780801	278	9.901585	159	9.879216	437	10.120784	10.098415	10.219199	52
9	9.780968	278	9.901490	159	9.879478	437	10.120522	10.098510	10.219032	51
10	9.781134	278	9.901394	160	9.879741	437	10.120259	10.098606	10.218866	50
11	9.781301	277	9.901298	160	9.880003	437	10.119997	10.098702	10.218699	49
12	9.781468	277	9.901202	160	9.880265	437	10.119735	10.098798	10.218532	48
13	9.781634	277	9.901106	160	9.880528	437	10.119472	10.098894	10.218366	47
14	9.781800	277	9.901010	160	9.880790	437	10.119210	10.098990	10.218200	46
15	9.781966	277	9.900914	160	9.881052	437	10.118948	10.099086	10.218034	45
16	9.782132	277	9.900818	160	9.881314	437	10.118686	10.099182	10.217868	44
17	9.782298	276	9.900722	160	9.881576	437	10.118424	10.099278	10.217702	43
18	9.782464	276	9.900626	160	9.881839	437	10.118161	10.099374	10.217536	42
19	9.782630	276	9.900529	160	9.882101	437	10.117899	10.099471	10.217370	41
20	9.782796	276	9.900433	161	9.882363	437	10.117637	10.099567	10.217204	40
21	9.782961	276	9.900337	161	9.882625	436	10.117375	10.099663	10.217039	39
22	9.783127	276	9.900240	161	9.882887	436	10.117113	10.099760	10.216873	38
23	9.783292	275	9.900144	161	9.883148	436	10.116852	10.099856	10.216708	37
24	9.783458	275	9.900047	161	9.883410	436	10.116590	10.099953	10.216542	36
25	9.783623	275	9.899951	161	9.883672	436	10.116328	10.100049	10.216377	35
26	9.783788	275	9.899854	161	9.883934	436	10.116066	10.100146	10.216212	34
27	9.783953	275	9.899757	161	9.884196	436	10.115804	10.100243	10.216047	33
28	9.784118	275	9.899660	161	9.884457	436	10.115543	10.100340	10.215882	32
29	9.784282	274	9.899564	161	9.884719	436	10.115281	10.100436	10.215718	31
30	9.784447	274	9.899467	162	9.884980	436	10.115020	10.100533	10.215553	30
31	9.784612	274	9.899370	162	9.885242	436	10.114758	10.100630	10.215388	29
32	9.784776	274	9.899273	162	9.885503	436	10.114497	10.100727	10.215224	28
33	9.784941	274	9.899176	162	9.885765	436	10.114235	10.100824	10.215059	27
34	9.785105	274	9.899078	162	9.886026	436	10.113974	10.100922	10.214895	26
35	9.785269	273	9.898981	162	9.886288	436	10.113712	10.101019	10.214731	25
36	9.785433	273	9.898884	162	9.886549	436	10.113451	10.101116	10.214567	24
37	9.785597	273	9.898787	162	9.886810	435	10.113190	10.101213	10.214403	23
38	9.785761	273	9.898689	162	9.887072	435	10.112928	10.101311	10.214239	22
39	9.785925	273	9.898592	162	9.887333	435	10.112667	10.101408	10.214075	21
40	9.786089	273	9.898494	163	9.887594	435	10.112406	10.101506	10.213911	20
41	9.786252	272	9.898397	163	9.887855	435	10.112145	10.101603	10.213748	19
42	9.786416	272	9.898299	163	9.888116	435	10.111884	10.101701	10.213584	18
43	9.786579	272	9.898202	163	9.888377	435	10.111623	10.101798	10.213421	17
44	9.786742	272	9.898104	163	9.888639	435	10.111361	10.101896	10.213258	16
45	9.786906	272	9.898006	163	9.888900	435	10.111100	10.101994	10.213094	15
46	9.787069	272	9.897908	163	9.889160	435	10.110840	10.102092	10.212931	14
47	9.787232	271	9.897810	163	9.889421	435	10.110579	10.102190	10.212768	13
48	9.787395	271	9.897712	163	9.889682	435	10.110318	10.102288	10.212605	12
49	9.787557	271	9.897614	163	9.889943	435	10.110057	10.102386	10.212443	11
50	9.787720	271	9.897516	163	9.890204	435	10.109796	10.102484	10.212280	10
51	9.787883	271	9.897418	164	9.890465	435	10.109535	10.102582	10.212117	9
52	9.788045	271	9.897320	164	9.890725	434	10.109275	10.102680	10.211955	8
53	9.788208	271	9.897222	164	9.890986	434	10.109014	10.102778	10.211792	7
54	9.788370	270	9.897123	164	9.891247	434	10.108753	10.102877	10.211630	6
55	9.788532	270	9.897025	164	9.891507	434	10.108493	10.102975	10.211468	5
56	9.788694	270	9.896926	164	9.891768	434	10.108232	10.103074	10.211306	4
57	9.788856	270	9.896828	164	9.892028	434	10.107972	10.103172	10.211144	3
58	9.789018	270	9.896729	164	9.892289	434	10.107711	10.103271	10.210982	2
59	9.789180	270	9.896631	164	9.892549	434	10.107451	10.103369	10.210820	1
60	9.789342		9.896532		9.892810		10.107190	10.103468	10.210658	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant:	M

52 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

38 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.789342	269	9.896532	164	9.892810	434	10.107190	10.103468	10.210658	60
1	9.789504	269	9.896433	165	9.893070	434	10.106930	10.103567	10.210496	59
2	9.789665	269	9.896335	165	9.893331	434	10.106669	10.103665	10.210335	58
3	9.789827	269	9.896236	165	9.893591	434	10.106409	10.103764	10.210173	57
4	9.789988	269	9.896137	165	9.893851	434	10.106149	10.103863	10.210012	56
5	9.790149	269	9.896038	165	9.894111	434	10.105889	10.103962	10.209851	55
6	9.790310	268	9.895939	165	9.894371	434	10.105629	10.104061	10.209690	54
7	9.790471	268	9.895840	165	9.894632	434	10.105368	10.104160	10.209529	53
8	9.790632	268	9.895741	165	9.894892	433	10.105108	10.104259	10.209368	52
9	9.790793	268	9.895641	165	9.895152	433	10.104848	10.104359	10.209207	51
10	9.790954	268	9.895542	165	9.895412	433	10.104588	10.104458	10.209046	50
11	9.791115	268	9.895443	166	9.895672	433	10.104328	10.104557	10.208885	49
12	9.791275	267	9.895343	166	9.895932	433	10.104068	10.104657	10.208725	48
13	9.791436	267	9.895244	166	9.896192	433	10.103808	10.104756	10.208564	47
14	9.791596	267	9.895145	166	9.896452	433	10.103548	10.104855	10.208404	46
15	9.791757	267	9.895045	166	9.896712	433	10.103288	10.104955	10.208243	45
16	9.791917	267	9.894945	166	9.896971	433	10.103029	10.105055	10.208083	44
17	9.792077	267	9.894846	166	9.897231	433	10.102769	10.105154	10.207923	43
18	9.792237	266	9.894746	166	9.897491	433	10.102509	10.105254	10.207763	42
19	9.792397	266	9.894646	166	9.897751	433	10.102249	10.105354	10.207603	41
20	9.792557	266	9.894546	166	9.898010	433	10.101990	10.105454	10.207443	40
21	9.792716	266	9.894446	167	9.898270	433	10.101730	10.105554	10.207284	39
22	9.792876	266	9.894346	167	9.898530	433	10.101470	10.105654	10.207124	38
23	9.793035	266	9.894246	167	9.898789	433	10.101211	10.105754	10.206965	37
24	9.793195	265	9.894146	167	9.899049	432	10.100951	10.105854	10.206805	36
25	9.793354	265	9.894046	167	9.899308	432	10.100692	10.105954	10.206646	35
26	9.793514	265	9.893946	167	9.899568	432	10.100432	10.106054	10.206486	34
27	9.793673	265	9.893846	167	9.899827	432	10.100173	10.106154	10.206327	33
28	9.793832	265	9.893745	167	9.900086	432	10.099914	10.106255	10.206168	32
29	9.793991	265	9.893645	167	9.900346	432	10.099654	10.106355	10.206009	31
30	9.794150	264	9.893544	167	9.900605	432	10.099395	10.106456	10.205850	30
31	9.794308	264	9.893444	168	9.900864	432	10.099136	10.106556	10.205692	29
32	9.794467	264	9.893343	168	9.901124	432	10.098876	10.106657	10.205533	28
33	9.794626	264	9.893243	168	9.901383	432	10.098617	10.106757	10.205374	27
34	9.794784	264	9.893142	168	9.901642	432	10.098358	10.106858	10.205216	26
35	9.794942	264	9.893041	168	9.901901	432	10.098099	10.106959	10.205058	25
36	9.795101	264	9.892940	168	9.902160	432	10.097840	10.107060	10.204899	24
37	9.795259	263	9.892839	168	9.902419	432	10.097581	10.107161	10.204741	23
38	9.795417	263	9.892739	168	9.902679	432	10.097321	10.107261	10.204583	22
39	9.795575	263	9.892638	168	9.902938	432	10.097062	10.107362	10.204425	21
40	9.795733	263	9.892536	168	9.903197	432	10.096803	10.107464	10.204267	20
41	9.795891	263	9.892435	169	9.903455	431	10.096545	10.107565	10.204109	19
42	9.796049	263	9.892334	169	9.903714	431	10.096286	10.107666	10.203951	18
43	9.796206	263	9.892233	169	9.903973	431	10.096027	10.107767	10.203794	17
44	9.796364	262	9.892132	169	9.904232	431	10.095768	10.107868	10.203636	16
45	9.796521	262	9.892030	169	9.904491	431	10.095509	10.107970	10.203479	15
46	9.796679	262	9.891929	169	9.904750	431	10.095250	10.108071	10.203321	14
47	9.796836	262	9.891827	169	9.905008	431	10.094992	10.108173	10.203164	13
48	9.796993	262	9.891726	169	9.905267	431	10.094733	10.108274	10.203007	12
49	9.797150	262	9.891624	169	9.905526	431	10.094474	10.108376	10.202850	11
50	9.797307	261	9.891523	169	9.905784	431	10.094216	10.108477	10.202693	10
51	9.797464	261	9.891421	170	9.906043	431	10.093957	10.108579	10.202536	9
52	9.797621	261	9.891319	170	9.906302	431	10.093698	10.108681	10.202379	8
53	9.797777	261	9.891217	170	9.906560	431	10.093440	10.108783	10.202223	7
54	9.797934	261	9.891115	170	9.906819	431	10.093181	10.108885	10.202066	6
55	9.798091	261	9.891013	170	9.907077	431	10.092923	10.108987	10.201909	5
56	9.798247	261	9.890911	170	9.907336	431	10.092664	10.109089	10.201753	4
57	9.798403	260	9.890809	170	9.907594	431	10.092406	10.109191	10.201597	3
58	9.798560	260	9.890707	170	9.907852	431	10.092148	10.109293	10.201440	2
59	9.798716	260	9.890605	170	9.908111	431	10.091889	10.109395	10.201284	1
60	9.798872		9.890503		9.908369		10.091631	10.109497	10.201128	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

51 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

39 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.798872	260	9.890503	170	9.908369	430	10.091631	10.109497	10.201128	60
1	9.799028	260	9.890400	171	9.908628	430	10.091372	10.109600	10.200972	59
2	9.799184	260	9.890298	171	9.908886	430	10.091114	10.109702	10.200816	58
3	9.799339	259	9.890195	171	9.909144	430	10.090856	10.109805	10.200661	57
4	9.799495	259	9.890093	171	9.909402	430	10.090598	10.109907	10.200505	56
5	9.799651	259	9.889990	171	9.909660	430	10.090340	10.110010	10.200349	55
6	9.799806	259	9.889888	171	9.909918	430	10.090082	10.110112	10.200194	54
7	9.799962	259	9.889785	171	9.910177	430	10.089823	10.110215	10.200038	53
8	9.800117	259	9.889682	171	9.910435	430	10.089565	10.110318	10.199883	52
9	9.800272	258	9.889579	171	9.910693	430	10.089307	10.110421	10.199728	51
10	9.800427	258	9.889477	171	9.910951	430	10.089049	10.110523	10.199573	50
11	9.800582	258	9.889374	172	9.911209	430	10.088791	10.110626	10.199418	49
12	9.800737	258	9.889271	172	9.911467	430	10.088533	10.110729	10.199263	48
13	9.800892	258	9.889168	172	9.911724	430	10.088276	10.110832	10.199108	47
14	9.801047	258	9.889064	172	9.911982	430	10.088018	10.110936	10.198953	46
15	9.801201	258	9.888961	172	9.912240	430	10.087760	10.111039	10.198799	45
16	9.801356	257	9.888858	172	9.912498	430	10.087502	10.111142	10.198644	44
17	9.801511	257	9.888755	172	9.912756	430	10.087244	10.111245	10.198489	43
18	9.801665	257	9.888651	172	9.913014	430	10.086986	10.111349	10.198335	42
19	9.801819	257	9.888548	172	9.913271	429	10.086729	10.111452	10.198181	41
20	9.801973	257	9.888444	173	9.913529	429	10.086471	10.111556	10.198027	40
21	9.802128	257	9.888341	173	9.913787	429	10.086213	10.111659	10.197872	39
22	9.802282	256	9.888237	173	9.914044	429	10.085956	10.111763	10.197718	38
23	9.802436	256	9.888134	173	9.914302	429	10.085698	10.111866	10.197564	37
24	9.802589	256	9.888030	173	9.914560	429	10.085440	10.111970	10.197411	36
25	9.802743	256	9.887926	173	9.914817	429	10.085183	10.112074	10.197257	35
26	9.802897	256	9.887822	173	9.915075	429	10.084925	10.112178	10.197103	34
27	9.803050	256	9.887718	173	9.915332	429	10.084668	10.112282	10.196950	33
28	9.803204	256	9.887614	173	9.915590	429	10.084410	10.112386	10.196796	32
29	9.803357	255	9.887510	173	9.915847	429	10.084153	10.112490	10.196643	31
30	9.803511	255	9.887406	174	9.916104	429	10.083896	10.112594	10.196489	30
31	9.803664	255	9.887302	174	9.916362	429	10.083638	10.112698	10.196336	29
32	9.803817	255	9.887198	174	9.916619	429	10.083381	10.112802	10.196183	28
33	9.803970	255	9.887093	174	9.916877	429	10.083123	10.112907	10.196030	27
34	9.804123	255	9.886989	174	9.917134	429	10.082866	10.113011	10.195877	26
35	9.804276	254	9.886885	174	9.917391	429	10.082609	10.113115	10.195724	25
36	9.804428	254	9.886780	174	9.917648	429	10.082352	10.113220	10.195572	24
37	9.804581	254	9.886676	174	9.917905	429	10.082095	10.113324	10.195419	23
38	9.804734	254	9.886571	174	9.918163	429	10.081837	10.113429	10.195266	22
39	9.804886	254	9.886466	174	9.918420	429	10.081580	10.113534	10.195114	21
40	9.805039	254	9.886362	175	9.918677	429	10.081323	10.113638	10.194961	20
41	9.805191	254	9.886257	175	9.918934	428	10.081066	10.113743	10.194809	19
42	9.805343	253	9.886152	175	9.919191	428	10.080809	10.113848	10.194657	18
43	9.805495	253	9.886047	175	9.919448	428	10.080552	10.113953	10.194505	17
44	9.805647	253	9.885942	175	9.919705	428	10.080295	10.114058	10.194353	16
45	9.805799	253	9.885837	175	9.919962	428	10.080038	10.114163	10.194201	15
46	9.805951	253	9.885732	175	9.920219	428	10.079781	10.114268	10.194049	14
47	9.806103	253	9.885627	175	9.920476	428	10.079524	10.114373	10.193897	13
48	9.806254	253	9.885522	175	9.920733	428	10.079267	10.114478	10.193746	12
49	9.806406	252	9.885416	175	9.920990	428	10.079010	10.114584	10.193594	11
50	9.806557	252	9.885311	176	9.921247	428	10.078753	10.114689	10.193443	10
51	9.806709	252	9.885205	176	9.921503	428	10.078497	10.114795	10.193291	9
52	9.806860	252	9.885100	176	9.921760	428	10.078240	10.114900	10.193140	8
53	9.807011	252	9.884994	176	9.922017	428	10.077983	10.115006	10.192989	7
54	9.807163	252	9.884889	176	9.922274	428	10.077726	10.115111	10.192837	6
55	9.807314	252	9.884783	176	9.922530	428	10.077470	10.115217	10.192686	5
56	9.807465	251	9.884677	176	9.922787	428	10.077213	10.115323	10.192535	4
57	9.807615	251	9.884572	176	9.923044	428	10.076956	10.115428	10.192385	3
58	9.807766	251	9.884466	176	9.923300	428	10.076700	10.115534	10.192234	2
59	9.807917	251	9.884360	176	9.923557	428	10.076443	10.115640	10.192083	1
60	9.808067		9.884254		9.923813		10.076187	10.115746	10.191933	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

50 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

40 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.808067	251	9.884254	177	9.923813	428	10.076187	10.115746	10.191933	60
1	9.808218	251	9.884148	177	9.924070	428	10.075930	10.115852	10.191782	59
2	9.808368	251	9.884042	177	9.924327	428	10.075673	10.115958	10.191632	58
3	9.808519	250	9.883936	177	9.924583	427	10.075417	10.116064	10.191481	57
4	9.808669	250	9.883829	177	9.924840	427	10.075160	10.116171	10.191331	56
5	9.808819	250	9.883723	177	9.925096	427	10.074904	10.116277	10.191181	55
6	9.808969	250	9.883617	177	9.925352	427	10.074648	10.116383	10.191031	54
7	9.809119	250	9.883510	177	9.925609	427	10.074391	10.116490	10.190881	53
8	9.809269	250	9.883404	177	9.925865	427	10.074135	10.116596	10.190731	52
9	9.809419	249	9.883297	178	9.926122	427	10.073878	10.116703	10.190581	51
10	9.809569	249	9.883191	178	9.926378	427	10.073622	10.116809	10.190431	50
11	9.809718	249	9.883084	178	9.926634	427	10.073366	10.116916	10.190282	49
12	9.809868	249	9.882977	178	9.926890	427	10.073110	10.117023	10.190132	48
13	9.810017	249	9.882871	178	9.927147	427	10.072853	10.117129	10.189983	47
14	9.810167	249	9.882764	178	9.927403	427	10.072597	10.117236	10.189833	46
15	9.810316	248	9.882657	178	9.927659	427	10.072341	10.117343	10.189684	45
16	9.810465	248	9.882550	178	9.927915	427	10.072085	10.117450	10.189535	44
17	9.810614	248	9.882443	178	9.928171	427	10.071829	10.117557	10.189386	43
18	9.810763	248	9.882336	179	9.928427	427	10.071573	10.117664	10.189237	42
19	9.810912	248	9.882229	179	9.928683	427	10.071317	10.117771	10.189088	41
20	9.811061	248	9.882121	179	9.928940	427	10.071060	10.117879	10.188939	40
21	9.811210	248	9.882014	179	9.929196	427	10.070804	10.117986	10.188790	39
22	9.811358	247	9.881907	179	9.929452	427	10.070548	10.118093	10.188642	38
23	9.811507	247	9.881799	179	9.929708	427	10.070292	10.118201	10.188493	37
24	9.811655	247	9.881692	179	9.929964	427	10.070036	10.118308	10.188345	36
25	9.811804	247	9.881584	179	9.930220	427	10.069780	10.118416	10.188196	35
26	9.811952	247	9.881477	179	9.930475	427	10.069525	10.118523	10.188048	34
27	9.812100	247	9.881369	179	9.930731	426	10.069269	10.118631	10.187900	33
28	9.812248	247	9.881261	180	9.930987	426	10.069013	10.118739	10.187752	32
29	9.812396	246	9.881153	180	9.931243	426	10.068757	10.118847	10.187604	31
30	9.812544	246	9.881046	180	9.931499	426	10.068501	10.118954	10.187456	30
31	9.812692	246	9.880938	180	9.931755	426	10.068245	10.119062	10.187308	29
32	9.812840	246	9.880830	180	9.932010	426	10.067990	10.119170	10.187160	28
33	9.812988	246	9.880722	180	9.932266	426	10.067734	10.119278	10.187012	27
34	9.813135	246	9.880613	180	9.932522	426	10.067478	10.119387	10.186865	26
35	9.813283	246	9.880505	180	9.932778	426	10.067222	10.119495	10.186717	25
36	9.813430	245	9.880397	180	9.933033	426	10.066967	10.119603	10.186570	24
37	9.813578	245	9.880289	181	9.933289	426	10.066711	10.119711	10.186422	23
38	9.813725	245	9.880180	181	9.933545	426	10.066455	10.119820	10.186275	22
39	9.813872	245	9.880072	181	9.933800	425	10.066200	10.119928	10.186128	21
40	9.814019	245	9.879963	181	9.934056	426	10.065944	10.120037	10.185981	20
41	9.814166	245	9.879855	181	9.934311	426	10.065689	10.120145	10.185834	19
42	9.814313	245	9.879746	181	9.934567	426	10.065433	10.120254	10.185687	18
43	9.814460	244	9.879637	181	9.934823	426	10.065177	10.120363	10.185540	17
44	9.814607	244	9.879529	181	9.935078	426	10.064922	10.120471	10.185393	16
45	9.814753	244	9.879420	181	9.935333	426	10.064667	10.120580	10.185247	15
46	9.814900	244	9.879311	181	9.935589	426	10.064411	10.120689	10.185100	14
47	9.815046	244	9.879202	182	9.935844	426	10.064156	10.120798	10.184954	13
48	9.815193	244	9.879093	182	9.936100	426	10.063900	10.120907	10.184807	12
49	9.815339	244	9.878984	182	9.936355	426	10.063645	10.121016	10.184661	11
50	9.815485	243	9.878875	182	9.936610	426	10 063390	10.121125	10.184515	10
51	9.815632	243	9.878766	182	9.936866	426	10.063134	10.121234	10.184368	9
52	9.815778	243	9.878656	182	9.937121	426	10.062879	10.121344	10.184222	8
53	9.815924	243	9.878547	182	9.937376	425	10.062624	10.121453	10.184076	7
54	9.816069	243	9.878438	182	9.937632	425	10.062368	10.121562	10.183931	6
55	9.816215	243	9.878328	182	9.937887	425	10.062113	10.121672	10.183785	5
56	9.816361	243	9.878219	183	9.938142	425	10.061858	10.121781	10.183639	4
57	9.816507	242	9.878109	183	9.938398	425	10.061602	10.121891	10.183493	3
58	9.816652	242	9.877999	183	9.938653	425	10.061347	10.122001	10.183348	2
59	9.816798	242	9.877890	183	9.938908	425	10.061092	10.122110	10.183202	1
60	9.816943		9.877780		9.939163		10.060837	10.122220	10.183057	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

49 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

41 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.816943	242	9.877780	183	9.939163	425	10.060837	10.122220	10.183057	60
1	9.817088	242	9.877670	183	9.939418	425	10.060582	10.122330	10.182912	59
2	9.817233	242	9.877560	183	9.939673	425	10.060327	10.122440	10.182767	58
3	9.817379	242	9.877450	183	9.939928	425	10.060072	10.122550	10.182621	57
4	9.817524	241	9.877340	183	9.940183	425	10.059817	10.122660	10.182476	56
5	9.817668	241	9.877230	184	9.940438	425	10.059562	10.122770	10.182332	55
6	9.817813	241	9.877120	184	9.940694	425	10.059306	10.122880	10.182187	54
7	9.817958	241	9.877010	184	9.940949	425	10.059051	10.122990	10.182042	53
8	9.818103	241	9.876899	184	9.941204	425	10.058796	10.123101	10.181897	52
9	9.818247	241	9.876789	184	9.941458	425	10.058542	10.123211	10.181753	51
10	9.818392	241	9.876678	184	9.941714	425	10.058286	10.123322	10.181608	50
11	9.818536	240	9.876568	184	9.941968	425	10.058032	10.123432	10.181464	49
12	9.818681	240	9.876457	184	9.942223	425	10.057777	10.123543	10.181319	48
13	9.818825	240	9.876347	184	9.942478	425	10.057522	10.123653	10.181175	47
14	9.818969	240	9.876236	185	9.942733	425	10.057267	10.123764	10.181031	46
15	9.819113	240	9.876125	185	9.942988	425	10.057012	10.123875	10.180887	45
16	9.819257	240	9.876014	185	9.943243	425	10.056757	10.123986	10.180743	44
17	9.819401	240	9.875904	185	9.943498	425	10.056502	10.124096	10.180599	43
18	9.819545	239	9.875793	185	9.943752	425	10.056248	10.124207	10.180455	42
19	9.819689	239	9.875682	185	9.944007	425	10.055993	10.124318	10.180311	41
20	9.819832	239	9.875571	185	9.944262	425	10.055738	10.124429	10.180168	40
21	9.819976	239	9.875459	185	9.944517	425	10.055483	10.124541	10.180024	39
22	9.820120	239	9.875348	185	9.944771	425	10.055229	10.124652	10.179880	38
23	9.820263	239	9.875237	185	9.945026	425	10.054974	10.124763	10.179737	37
24	9.820406	239	9.875126	186	9.945281	425	10.054719	10.124874	10.179594	36
25	9.820550	238	9.875014	186	9.945535	425	10.054465	10.124986	10.179450	35
26	9.820693	238	9.874903	186	9.945790	425	10.054210	10.125097	10.179307	34
27	9.820836	238	9.874791	186	9.946045	425	10.053955	10.125209	10.179164	33
28	9.820979	238	9.874680	186	9.946299	425	10.053701	10.125320	10.179021	32
29	9.821122	238	9.874568	186	9.946554	425	10.053446	10.125432	10.178878	31
30	9.821265	238	9.874456	186	9.946808	425	10.053192	10.125544	10.178735	30
31	9.821407	238	9.874344	186	9.947063	424	10.052937	10.125656	10.178593	29
32	9.821550	238	9.874232	186	9.947318	424	10.052682	10.125768	10.178450	28
33	9.821693	237	9.874121	187	9.947572	424	10.052428	10.125879	10.178307	27
34	9.821835	237	9.874009	187	9.947826	424	10.052174	10.125991	10.178165	26
35	9.821977	237	9.873896	187	9.948081	424	10.051919	10.126104	10.178023	25
36	9.822120	237	9.873784	187	9.948336	424	10.051664	10.126216	10.177880	24
37	9.822262	237	9.873672	187	9.948590	424	10.051410	10.126328	10.177738	23
38	9.822404	237	9.873560	187	9.948844	424	10.051156	10.126440	10.177596	22
39	9.822546	237	9.873448	187	9.949099	424	10.050901	10.126552	10.177454	21
40	9.822688	236	9.873335	187	9.949353	424	10.050647	10.126665	10.177312	20
41	9.822830	236	9.873223	187	9.949607	424	10.050393	10.126777	10.177170	19
42	9.822972	236	9.873110	188	9.949862	424	10.050138	10.126890	10.177028	18
43	9.823114	236	9.872998	188	9.950116	424	10.049884	10.127002	10.176886	17
44	9.823255	236	9.872885	188	9.950370	424	10.049630	10.127115	10.176745	16
45	9.823397	236	9.872772	188	9.950625	424	10.049375	10.127228	10.176603	15
46	9.823539	236	9.872659	188	9.950879	424	10.049121	10.127341	10.176461	14
47	9.823680	235	9.872547	188	9.951133	424	10.048867	10.127453	10.176320	13
48	9.823821	235	9.872434	188	9.951388	424	10.048612	10.127566	10.176179	12
49	9.823963	235	9.872321	188	9.951642	424	10.048358	10.127679	10.176037	11
50	9.824104	235	9.872208	188	9.951896	424	10.048104	10.127792	10.175896	10
51	9.824245	235	9.872095	189	9.952150	424	10.047850	10.127905	10.175755	9
52	9.824386	235	9.871981	189	9.952405	424	10.047595	10.128019	10.175614	8
53	9.824527	235	9.871868	189	9.952659	424	10.047341	10.128132	10.175473	7
54	9.824668	234	9.871755	189	9.952913	424	10.047087	10.128245	10.175332	6
55	9.824808	234	9.871641	189	9.953167	423	10.046833	10.128359	10.175192	5
56	9.824949	234	9.871528	189	9.953421	423	10.046579	10.128472	10.175051	4
57	9.825090	234	9.871414	189	9.953675	423	10.046325	10.128586	10.174910	3
58	9.825230	234	9.871301	189	9.953929	423	10.046071	10.128699	10.174770	2
59	9.825371	234	9.871187	189	9.954183	423	10.045817	10.128813	10.174629	1
60	9.825511		9.871073		9.954437		10.045563	10.128927	10.174489	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

48 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

42 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.825511	234	9.871073	190	9.954437	423	10.045563	10.128927	10.174489	60
1	9.825651	233	9.870960	190	9.954691	423	10.045309	10.129040	10.174349	59
2	9.825791	233	9.870846	190	9.954945	423	10.045055	10.129154	10.174209	58
3	9.825931	233	9.870732	190	9.955200	423	10.044800	10.129268	10.174069	57
4	9.826071	233	9.870618	190	9.955454	423	10.044546	10.129382	10.173929	56
5	9.826211	233	9.870504	190	9.955707	423	10.044293	10.129496	10.173789	55
6	9.826351	233	9.870390	190	9.955961	423	10.044039	10.129610	10.173649	54
7	9.826491	233	9.870276	190	9.956215	423	10.043785	10.129724	10.173509	53
8	9.826631	233	9.870161	190	9.956469	423	10.043531	10.129839	10.173369	52
9	9.826770	232	9.870047	191	9.956723	423	10.043277	10.129953	10.173230	51
10	9.826910	232	9.869933	191	9.956977	423	10.043023	10.130067	10.173090	50
11	9.827049	232	9.869818	191	9.957231	423	10.042769	10.130182	10.172951	49
12	9.827189	232	9.869704	191	9.957485	423	10.042515	10.130296	10.172811	48
13	9.827328	232	9.869589	191	9.957739	423	10.042261	10.130411	10.172672	47
14	9.827467	232	9.869474	191	9.957993	423	10.042007	10.130526	10.172533	46
15	9.827606	232	9.869360	191	9.958246	423	10.041754	10.130640	10.172394	45
16	9.827745	232	9.869245	191	9.958500	423	10.041500	10.130755	10.172255	44
17	9.827884	231	9.869130	191	9.958754	423	10.041246	10.130870	10.172116	43
18	9.828023	231	9.869015	192	9.959008	423	10.040992	10.130985	10.171977	42
19	9.828162	231	9.868900	192	9.959262	423	10.040738	10.131100	10.171838	41
20	9.828301	231	9.868785	192	9.959516	423	10.040484	10.131215	10.171699	40
21	9.828439	231	9.868670	192	9.959769	423	10.040231	10.131330	10.171561	39
22	9.828578	231	9.868555	192	9.960023	423	10.039977	10.131445	10.171422	38
23	9.828716	231	9.868440	192	9.960277	423	10.039723	10.131560	10.171284	37
24	9.828855	230	9.868324	192	9.960531	423	10.039469	10.131676	10.171145	36
25	9.828993	230	9.868209	192	9.960784	423	10.039216	10.131791	10.171007	35
26	9.829131	230	9.868093	192	9.961038	423	10.038962	10.131907	10.170869	34
27	9.829269	230	9.867978	193	9.961291	423	10.038709	10.132022	10.170731	33
28	9.829407	230	9.867862	193	9.961545	423	10.038455	10.132138	10.170593	32
29	9.829545	230	9.867747	193	9.961799	423	10.038201	10.132253	10.170455	31
30	9.829683	230	9.867631	193	9.962052	423	10.037948	10.132369	10.170317	30
31	9.829821	229	9.867515	193	9.962306	423	10.037694	10.132485	10.170179	29
32	9.829959	229	9.867399	193	9.962560	423	10.037440	10.132601	10.170041	28
33	9.830097	229	9.867283	193	9.962813	423	10.037187	10.132717	10.169903	27
34	9.830234	229	9.867167	193	9.963067	423	10.036933	10.132833	10.169766	26
35	9.830372	229	9.867051	193	9.963320	423	10.036680	10.132949	10.169628	25
36	9.830509	229	9.866935	194	9.963574	423	10.036426	10.133065	10.169491	24
37	9.830646	229	9.866819	194	9.963827	423	10.036173	10.133181	10.169354	23
38	9.830784	229	9.866703	194	9.964081	423	10.035919	10.133297	10.169216	22
39	9.830921	228	9.866586	194	9.964335	423	10.035665	10.133414	10.169079	21
40	9.831058	228	9.866470	194	9.964588	423	10.035412	10.133530	10.168942	20
41	9.831195	228	9.866353	194	9.964842	422	10.035158	10.133647	10.168805	19
42	9.831332	228	9.866237	194	9.965095	422	10.034905	10.133763	10.168668	18
43	9.831469	228	9.866120	194	9.965349	422	10.034651	10.133880	10.168531	17
44	9.831606	228	9.866004	195	9.965602	422	10.034398	10.133996	10.168394	16
45	9.831742	228	9.865887	195	9.965855	422	10.034145	10.134113	10.168258	15
46	9.831879	228	9.865770	195	9.966109	422	10.033891	10.134230	10.168121	14
47	9.832015	227	9.865653	195	9.966362	422	10.033638	10.134347	10.167985	13
48	9.832152	227	9.865536	195	9.966616	422	10.033384	10.134464	10.167848	12
49	9.832288	227	9.865419	195	9.966869	422	10.033131	10.134581	10.167712	11
50	9.832425	227	9.865302	195	9.967123	422	10.032877	10.134698	10.167575	10
51	9.832561	227	9.865185	195	9.967376	422	10.032624	10.134815	10.167439	9
52	9.832697	227	9.865068	195	9.967629	422	10.032371	10.134932	10.167303	8
53	9.832833	227	9.864950	195	9.967883	422	10.032117	10.135050	10.167167	7
54	9.832969	226	9.864833	196	9.968136	422	10.031864	10.135167	10.167031	6
55	9.833105	226	9.864716	196	9.968389	422	10.031611	10.135284	10.166895	5
56	9.833241	226	9.864598	196	9.968643	422	10.031357	10.135402	10.166759	4
57	9.833377	226	9.864481	196	9.968896	422	10.031104	10.135519	10.166623	3
58	9.833512	226	9.864363	196	9.969149	422	10.030851	10.135637	10.166488	2
59	9.833648	226	9.864245	196	9.969403	422	10.030597	10.135755	10.166352	1
60	9.833783		9.864127		9.969656		10.030344	10.135873	10.166217	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

47 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

43 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.833783	226	9.864127	196	9.969656	422	10.030344	10.135873	10.166217	60
1	9.833919	225	9.864010	196	9.969909	422	10.030091	10.135990	10.166081	59
2	9.834054	225	9.863892	197	9.970162	422	10.029838	10.136108	10.165946	58
3	9.834189	225	9.863774	197	9.970416	422	10.029584	10.136226	10.165811	57
4	9.834325	225	9.863656	197	9.970669	422	10.029331	10.136344	10.165675	56
5	9.834460	225	9.863538	197	9.970922	422	10.029078	10.136462	10.165540	55
6	9.834595	225	9.863419	197	9.971175	422	10.028825	10.136581	10.165405	54
7	9.834730	225	9.863301	197	9.971429	422	10.028571	10.136699	10.165270	53
8	9.834865	225	9.863183	197	9.971682	422	10.028318	10.136817	10.165135	52
9	9.834999	224	9.863064	197	9.971935	422	10.028065	10.136936	10.165001	51
10	9.835134	224	9.862946	198	9.972188	422	10.027812	10.137054	10.164866	50
11	9.835269	224	9.862827	198	9.972441	422	10.027559	10.137173	10.164731	49
12	9.835403	224	9.862709	198	9.972694	422	10.027306	10.137291	10.164597	48
13	9.835538	224	9.862590	198	9.972948	422	10.027052	10.137410	10.164462	47
14	9.835672	224	9.862471	198	9.973201	422	10.026799	10.137529	10.164328	46
15	9.835807	224	9.862353	198	9.973454	422	10.026546	10.137647	10.164193	45
16	9.835941	224	9.862234	198	9.973771	422	10.026293	10.137766	10.164059	44
17	9.836075	223	9.862115	198	9.973960	422	10.026040	10.137885	10.163925	43
18	9.836209	223	9.861996	198	9.974213	422	10.025787	10.138004	10.163791	42
19	9.836343	223	9.861877	198	9.974466	422	10.025534	10.138123	10.163657	41
20	9.836477	223	9.861758	199	9.974719	422	10.025281	10.138242	10.163523	40
21	9.836611	223	9.861638	199	9.974973	422	10.025027	10.138362	10.163389	39
22	9.836745	223	9.861519	199	9.975226	422	10.024774	10.138481	10.163255	38
23	9.836878	223	9.861400	199	9.975479	422	10.024521	10.138600	10.163122	37
24	9.837012	222	9.861280	199	9.975732	422	10.024268	10.138720	10.162988	36
25	9.837146	222	9.861161	199	9.975985	422	10.024015	10.138839	10.162854	35
26	9.837279	222	9.861041	199	9.976238	422	10.023762	10.138959	10.162721	34
27	9.837412	222	9.860922	199	9.976491	422	10.023509	10.139078	10.162588	33
28	9.837546	222	9.860802	199	9.976744	422	10.023256	10.139198	10.162454	32
29	9.837679	222	9.860682	200	9.976997	422	10.023003	10.139318	10.162321	31
30	9.837812	222	9.860562	200	9.977250	422	10.022750	10.139438	10.162188	30
31	9.837945	222	9.860442	200	9.977503	422	10.022497	10.139558	10.162055	29
32	9.838078	221	9.860322	200	9.977756	422	10.022244	10.139678	10.161922	28
33	9.838211	221	9.860202	200	9.978009	422	10.021991	10.139798	10.161789	27
34	9.838344	221	9.860082	200	9.978262	422	10.021738	10.139918	10.161656	26
35	9.838477	221	9.859962	200	9.978515	422	10.021485	10.140038	10.161523	25
36	9.838610	221	9.859842	200	9.978768	422	10.021232	10.140158	10.161390	24
37	9.838742	221	9.859721	201	9.979021	422	10.020979	10.140279	10.161258	23
38	9.838875	221	9.859601	201	9.979274	422	10.020726	10.140399	10.161125	22
39	9.839007	221	9.859480	201	9.979527	422	10.020473	10.140520	10.160993	21
40	9.839140	220	9.859360	201	9.979780	422	10.020220	10.140640	10.160860	20
41	9.839272	220	9.859239	201	9.980033	422	10.019967	10.140761	10.160728	19
42	9.839404	220	9.859119	201	9.980286	422	10.019714	10.140881	10.160596	18
43	9.839536	220	9.858998	201	9.980538	422	10.019462	10.141002	10.160464	17
44	9.839668	220	9.858877	201	9.980791	422	10.019209	10.141123	10.160332	16
45	9.839800	220	9.858756	202	9.981044	422	10.018956	10.141244	10.160200	15
46	9.839932	220	9.858635	202	9.981297	422	10.018703	10.141365	10.160068	14
47	9.840064	219	9.858514	202	9.981550	422	10.018450	10.141486	10.159936	13
48	9.840196	219	9.858393	202	9.981803	422	10.018197	10.141607	10.159804	12
49	9.840328	219	9.858272	202	9.982056	422	10.017944	10.141728	10.159672	11
50	9.840459	219	9.858151	202	9.982309	421	10.017691	10.141849	10.159541	10
51	9.840591	219	9.858029	202	9.982562	421	10.017438	10.141971	10.159409	9
52	9.840722	219	9.857908	202	9.982814	421	10.017186	10.142092	10.159278	8
53	9.840854	219	9.857786	202	9.983067	421	10.016933	10.142214	10.159146	7
54	9.840985	219	9.857665	203	9.983320	421	10.016680	10.142335	10.159015	6
55	9.841116	218	9.857543	203	9.983573	421	10.016427	10.142457	10.158884	5
56	9.841247	218	9.857422	203	9.983826	421	10.016174	10.142578	10.158753	4
57	9.841378	218	9.857300	203	9.984079	421	10.015921	10.142700	10.158622	3
58	9.841509	218	9.857178	203	9.984331	421	10.015669	10.142822	10.158491	2
59	9.841640	218	9.857056	203	9.984584	421	10.015416	10.142944	10.158360	1
60	9.841771		9.856934		9.984837		10.015163	10.143066	10.158229	0
M	Co-sine.		Sine.		Co-tang		Tang.	Co-sec.	Secant.	M

46 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

44 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tang.	Secant.	Co-sec.	M
0	9.841771	218	9.856934	203	9.984837	421	10.015163	10.143066	10.158229	60
1	9.841902	218	9.856812	203	9.985090	421	10.014910	10.143188	10.158098	59
2	9.842033	218	9.856690	204	9.985343	421	10.014657	10.143310	10.157967	58
3	9.842163	217	9.856568	204	9.985596	421	10.014404	10.143432	10.157837	57
4	9.842294	217	9.856446	204	9.985848	421	10.014152	10.143554	10.157706	56
5	9.842424	217	9.856323	204	9.986101	421	10.013899	10.143677	10.157576	55
6	9.842555	217	9.856201	204	9.986354	421	10.013646	10.143799	10.157445	54
7	9.842685	217	9.856078	204	9.986607	421	10.013393	10.143922	10.157315	53
8	9.842815	217	9.855956	204	9.986860	421	10.013140	10.144044	10.157185	52
9	9.842946	217	9.855833	204	9.987112	421	10.012888	10.144167	10.157054	51
10	9.843076	217	9.855711	205	9.987365	421	10.012635	10.144289	10.156924	50
11	9.843206	216	9.855588	205	9.987618	421	10.012382	10.144412	10.156794	49
12	9.843336	216	9.855465	205	9.987871	421	10.012129	10.144535	10.156664	48
13	9.843466	216	9.855342	205	9.988123	421	10.011877	10.144658	10.156534	47
14	9.843595	216	9.855219	205	9.988376	421	10.011624	10.144781	10.156405	46
15	9.843725	216	9.855096	205	9.988629	421	10.011371	10.144904	10.156275	45
16	9.843855	216	9.854973	205	9.988882	421	10.011118	10.145027	10.156145	44
17	9.843984	216	9.854850	205	9.989134	421	10.010866	10.145150	10.156016	43
18	9.844114	216	9.854727	206	9.989387	421	10.010613	10.145273	10.155886	42
19	9.844243	215	9.854603	206	9.989640	421	10.010360	10.145397	10.155757	41
20	9.844372	215	9.854480	206	9.989893	421	10.010107	10.145520	10.155628	40
21	9.844502	215	9.854356	206	9.990145	421	10.009855	10.145644	10.155498	39
22	9.844631	215	9.854233	206	9.990398	421	10.009602	10.145767	10.155369	38
23	9.844760	215	9.854109	206	9.990651	421	10.009349	10.145891	10.155240	37
24	9.844889	215	9.853986	206	9.990903	421	10.009097	10.146014	10.155111	36
25	9.845018	215	9.853862	206	9.991156	421	10.008844	10.146138	10.154982	35
26	9.845147	215	9.853738	206	9.991409	421	10.008591	10.146262	10.154853	34
27	9.845276	214	9.853614	207	9.991662	421	10.008338	10.146386	10.154724	33
28	9.845405	214	9.853490	207	9.991914	421	10.008086	10.146510	10.154595	32
29	9.845533	214	9.853366	207	9.992167	421	10.007833	10.146634	10.154467	31
30	9.845662	214	9.853242	207	9.992420	421	10.007580	10.146758	10.154338	30
31	9.845790	214	9.853118	207	9.992672	421	10.007328	10.146882	10.154210	29
32	9.845919	214	9.852994	207	9.992925	421	10.007075	10.147006	10.154081	28
33	9.846047	214	9.852869	207	9.993178	421	10.006822	10.147131	10.153953	27
34	9.846175	214	9.852745	207	9.993430	421	10.006570	10.147255	10.153825	26
35	9.846304	214	9.852620	207	9.993683	421	10.006317	10.147380	10.153696	25
36	9.846432	213	9.852496	208	9.993936	421	10.006064	10.147504	10.153568	24
37	9.846560	213	9.852371	208	9.994189	421	10.005811	10.147629	10.153440	23
38	9.846688	213	9.852247	208	9.994441	421	10.005559	10.147753	10.153312	22
39	9.846816	213	9.852122	208	9.994694	421	10.005306	10.147878	10.153184	21
40	9.846944	213	9.851997	208	9.994947	421	10.005053	10.148003	10.153056	20
41	9.847071	213	9.851872	208	9.995199	421	10.004801	10.148128	10.152929	19
42	9.847199	213	9.851747	208	9.995452	421	10.004548	10.148253	10.152801	18
43	9.847327	213	9.851622	208	9.995705	421	10.004295	10.148378	10.152673	17
44	9.847454	212	9.851497	209	9.995957	421	10.004043	10.148503	10.152546	16
45	9.847582	212	9.851372	209	9.996210	421	10.003790	10.148628	10.152418	15
46	9.847709	212	9.851246	209	9.996463	421	10.003537	10.148754	10.152291	14
47	9.847836	212	9.851121	209	9.996715	421	10.003285	10.148879	10.152164	13
48	9.847964	212	9.850996	209	9.996968	421	10.003032	10.149004	10.152036	12
49	9.848091	212	9.850870	209	9.997221	421	10.002779	10.149130	10.151909	11
50	9.848218	212	9.850745	209	9.997473	421	10.002527	10.149255	10.151782	10
51	9.848345	212	9.850619	209	9.997726	421	10.002274	10.149381	10.151655	9
52	9.848472	211	9.850493	210	9.997979	421	10.002021	10.149507	10.151528	8
53	9.848599	211	9.850368	210	9.998231	421	10.001769	10.149632	10.151401	7
54	9.848726	211	9.850242	210	9.998484	421	10.001516	10.149758	10.151274	6
55	9.848852	211	9.850116	210	9.998737	421	10.001263	10.149884	10.151148	5
56	9.848979	211	9.849990	210	9.998989	421	10.001011	10.150010	10.151021	4
57	9.849106	211	9.849864	210	9.999242	421	10.000758	10.150136	10.150894	3
58	9.849232	211	9.849738	210	9.999495	421	10.000505	10.150262	10.150768	2
59	9.849359	211	9.849611	210	9.999747	421	10.000253	10.150389	10.150641	1
60	9.849485		9.849485		10.000000		10.000000	10.150515	10.150515	0
M	Co-sine.		Sine.		Co-tang.		Tang.	Co-sec.	Secant.	M

45 Degrees

TABLE XXVI.—NATURAL SINES.

M	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	M
0	000000	017452	034899	052336	069756	087156	104528	121869	139173	156434	60
1	000291	017743	035190	052626	070047	087446	104818	122158	139461	156722	59
2	000582	018034	035481	052917	070337	087735	105107	122447	139749	157009	58
3	000873	018325	035772	053207	070627	088025	105396	122735	140037	157296	57
4	001164	018616	036062	053498	070917	088315	105686	123024	140325	157584	56
5	001454	018907	036353	053788	071207	088605	105975	123313	140613	157871	55
6	001745	019197	036644	054079	071497	088894	106264	123601	140901	158158	54
7	002036	019488	036934	054369	071788	089184	106553	123890	141189	158445	53
8	002327	019779	037225	054660	072078	089474	106843	124179	141477	158732	52
9	002618	020070	037516	054950	072368	089763	107132	124467	141765	159020	51
10	002909	020361	037806	055241	072658	090053	107421	124756	142053	159307	50
11	003200	020652	038097	055531	072948	090343	107710	125045	142341	159594	49
12	003491	020942	038388	055822	073238	090633	107999	125333	142629	159881	48
13	003782	021233	038678	056112	073528	090922	108289	125622	142917	160168	47
14	004072	021524	038969	056402	073818	091212	108578	125910	143205	160455	46
15	004363	021815	039260	056693	074108	091502	108867	126199	143493	160743	45
16	004654	022106	039550	056983	074399	091791	109156	126488	143780	161030	44
17	004945	022397	039841	057274	074689	092081	109445	126776	144068	161317	43
18	005236	022687	040132	057564	074979	092371	109734	127065	144356	161604	42
19	005527	022978	040422	057854	075269	092660	110023	127353	144644	161891	41
20	005818	023269	040713	058145	075559	092950	110313	127642	144932	162178	40
21	006109	023560	041004	058435	075849	093239	110602	127930	145220	162465	39
22	006399	023851	041294	058726	076139	093529	110891	128219	145507	162752	38
23	006690	024141	041585	059016	076429	093819	111180	128507	145795	163039	37
24	006981	024432	041876	059306	076719	094108	111469	128796	146083	163326	36
25	007272	024723	042166	059597	077009	094398	111758	129084	146371	163613	35
26	007563	025014	042457	059887	077299	094687	112047	129373	146659	163900	34
27	007854	025305	042748	060177	077589	094977	112336	129661	146946	164187	33
28	008145	025595	043038	060468	077879	095267	112625	129949	147234	164474	32
29	008436	025886	043329	060758	078169	095556	112914	130238	147522	164761	31
30	008727	026177	043619	061049	078459	095846	113203	130526	147809	165048	30
31	009017	026468	043910	061339	078749	096135	113492	130815	148097	165334	29
32	009308	026759	044201	061629	079039	096425	113781	131103	148385	165621	28
33	009599	027049	044491	061920	079329	096714	114070	131391	148672	165908	27
34	009890	027340	044782	062210	079619	097004	114359	131680	148960	166195	26
35	010181	027631	045072	062500	079909	097293	114648	131968	149248	166482	25
36	010472	027922	045363	062791	080199	097583	114937	132256	149535	166769	24
37	010763	028212	045654	063081	080489	097872	115226	132545	149823	167056	23
38	011054	028503	045944	063371	080779	098162	115515	132833	150111	167342	22
39	011344	028794	046235	063661	081069	098451	115804	133121	150398	167629	21
40	011635	029085	046525	063952	081359	098741	116093	133410	150686	167916	20
41	011926	029375	046816	064242	081649	099030	116382	133698	150973	168203	19
42	012217	029666	047106	064532	081939	099320	116671	133986	151261	168489	18
43	012508	029957	047397	064823	082228	099609	116960	134274	151548	168776	17
44	012799	030248	047688	065113	082518	099899	117249	13456.	151836	169063	16
45	013090	030539	047978	065403	082808	100188	117537	134851	152123	169350	15
46	013380	030829	048269	065693	083098	100477	117826	135139	152411	169636	14
47	013671	031120	048559	065984	083388	100767	118115	135427	152698	169923	13
48	013962	031411	048850	066274	083678	101056	118404	135716	152986	170209	12
49	014253	031702	049140	066564	083968	101346	118693	136004	153273	170496	11
50	014544	031992	049431	066854	084258	101635	118982	136292	153561	170783	10
51	014835	032283	049721	067145	084547	101924	119270	136580	153848	171069	9
52	015126	032574	050012	067435	084837	102214	119559	136868	154136	171356	8
53	015416	032864	050302	067725	085127	102503	119848	137156	154423	171643	7
54	015707	033155	050593	068015	085417	102793	120137	137445	154710	171929	6
55	015998	033446	050883	068306	085707	103082	120426	137733	154998	172216	5
56	016289	033737	051174	068596	085997	103371	120714	138021	155285	172502	4
57	016580	034027	051464	068886	086286	103661	121003	138309	155572	172789	3
58	016871	034318	051755	069176	086576	103950	121292	138597	155860	173075	2
59	017162	034609	052045	069466	086866	104239	121581	138885	156147	173362	1
60	017452	034899	052336	069756	087156	104528	121869	139173	156434	173648	0
M	89°	88°	87°	86°	85°	84°	83°	82°	81°	80°	M

Natural Co-sines.

Diff. to 100″	485	485	484	484	483	483	482	481	480	478	X

M	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	M
0	173648	190809	207912	224951	241922	258819	275637	292372	309017	325568	60
1	173935	191095	208196	225234	242204	259100	275917	292650	309294	325843	59
2	174221	191380	208481	225518	242486	259381	276197	292928	309570	326118	58
3	174508	191666	208765	225801	242769	259662	276476	293206	309847	326393	57
4	174794	191951	209050	226085	243051	259943	276756	293484	310123	326668	56
5	175080	192237	209334	226368	243333	260224	277035	293762	310400	326943	55
6	175367	192522	209619	226651	243615	260505	277315	294040	310676	327218	54
7	175653	192807	209903	226935	243897	260785	277594	294318	310953	327493	53
8	175939	193093	210187	227218	244179	261066	277874	294596	311229	327768	52
9	176226	193378	210472	227501	244461	261347	278153	294874	311506	328042	51
10	176512	193664	210756	227784	244743	261628	278432	295152	311782	328317	50
11	176798	193949	211040	228068	245025	261908	278712	295430	312059	328592	49
12	177085	194234	211325	228351	245307	262189	278991	295708	312335	328867	48
13	177371	194520	211609	228634	245589	262470	279270	295986	312611	329141	47
14	177657	194805	211893	228917	245871	262751	279550	296264	312888	329416	46
15	177944	195090	212178	229200	246153	263031	279829	296542	313164	329691	45
16	178230	195376	212462	229484	246435	263312	280108	296819	313440	329965	44
17	178516	195661	212746	229767	246717	263592	280388	297097	313716	330240	43
18	178802	195946	213030	230050	246999	263873	280667	297375	313992	330514	42
19	179088	196231	213315	230333	247281	264154	280946	297653	314269	330789	41
20	179375	196517	213599	230616	247563	264434	281225	297930	314545	331063	40
21	179661	196802	213883	230899	247845	264715	281504	298208	314821	331338	39
22	179947	197087	214167	231182	248126	264995	281783	298486	315097	331612	38
23	180233	197372	214451	231465	248408	265276	282062	298763	315373	331887	37
24	180519	197657	214735	231748	248690	265556	282341	299041	315649	332161	36
25	180805	197942	215019	232031	248972	265837	282620	299318	315925	332435	35
26	181091	198228	215303	232314	249253	266117	282900	299596	316201	332710	34
27	181377	198513	215588	232597	249535	266397	283179	299873	316477	332984	33
28	181663	198798	215872	232880	249817	266678	283457	300151	316753	333258	32
29	181950	199083	216156	233163	250098	266958	283736	300428	317029	333533	31
30	182236	199368	216440	233445	250380	267238	284015	300706	317305	333807	30
31	182522	199653	216724	233728	250662	267519	284294	300983	317580	334081	29
32	182808	199938	217008	234011	250943	267799	284573	301261	317856	334355	28
33	183094	200223	217292	234294	251225	268079	284852	301538	318132	334629	27
34	183379	200508	217575	234577	251506	268359	285131	301815	318408	334903	26
35	183665	200793	217859	234859	251788	268640	285410	302093	318684	335178	25
36	183951	201078	218143	235142	252069	268920	285688	302370	318959	335452	24
37	184237	201363	218427	235425	252351	269200	285967	302647	319235	335726	23
38	184523	201648	218711	235708	252632	269480	286246	302924	319511	336000	22
39	184809	201933	218995	235990	252914	269760	286525	303202	319786	336274	21
40	185095	202218	219279	236273	253195	270040	286803	303479	320062	336547	20
41	185381	202502	219562	236556	253477	270320	287082	303756	320337	336821	19
42	185667	202787	219846	236838	253758	270600	287361	304033	320613	337095	18
43	185952	203072	220130	237121	254039	270880	287639	304310	320889	337369	17
44	186238	203357	220414	237403	254321	271160	287918	304587	321164	337643	16
45	186524	203642	220697	237686	254602	271440	288196	304864	321439	337917	15
46	186810	203927	220981	237968	254883	271720	288475	305141	321715	338190	14
47	187096	204211	221265	238251	255165	272000	288753	305418	321990	338464	13
48	187381	204496	221548	238533	255446	272280	289032	305695	322266	338738	12
49	187667	204781	221832	238816	255727	272560	289310	305972	322541	339012	11
50	187953	205065	222116	239098	256008	272840	289589	306249	322816	339285	10
51	188238	205350	222399	239381	256289	273120	289867	306526	323092	339559	9
52	188524	205635	222683	239663	256571	273400	290145	306803	323367	339832	8
53	188810	205920	222967	239946	256852	273679	290424	307080	323642	340106	7
54	189095	206204	223250	240228	257133	273959	290702	307357	323917	340380	6
55	189381	206489	223534	240510	257414	274239	290981	307633	324193	340653	5
56	189667	206773	223817	240793	257695	274519	291259	307910	324468	340927	4
57	189952	207058	224101	241075	257976	274798	291537	308187	324743	341200	3
58	190238	207343	224384	241357	258257	275078	291815	308464	325018	341473	2
59	190523	207627	224668	241640	258538	275358	292094	308740	325293	341747	1
60	190809	207912	224951	241922	258819	275637	292372	309017	325568	342020	0
M	79°	78°	77°	76°	75°	74°	73°	72°	71°	70°	M

Natural Co-sines.

Diff. to 100″	477	475	473	471	469	467	465	462	460	457	

TABLE XXVI.—NATURAL SINES.

M	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	M
0	342020	358368	374607	390731	406737	422618	438371	453990	469472	484810	60
1	342293	358640	374876	390999	407002	422882	438633	454250	469728	485064	59
2	342567	358911	375146	391267	407268	423145	438894	454509	469985	485318	58
3	342840	359183	375416	391534	407534	423409	439155	454768	470242	485573	57
4	343113	359454	375685	391802	407799	423673	439417	455027	470499	485827	56
5	343387	359725	375955	392070	408065	423936	439678	455286	470755	486081	55
6	343660	359997	376224	392337	408330	424199	439939	455545	471012	486335	54
7	343933	360268	376494	392605	408596	424463	440200	455804	471268	486590	53
8	344206	360540	376763	392872	408861	424726	440462	456063	471525	486844	52
9	344479	360811	377033	393140	409127	424990	440723	456322	471782	487098	51
10	344752	361082	377302	393407	409392	425253	440984	456580	472038	487352	50
11	345025	361353	377571	393675	409658	425516	441245	456839	472294	487606	49
12	345298	361625	377841	393942	409923	425779	441506	457098	472551	487860	48
13	345571	361896	378110	394209	410188	426042	441767	457357	472807	488114	47
14	345844	362167	378379	394477	410454	426306	442028	457615	473063	488367	46
15	346117	362438	378649	394744	410719	426569	442289	457874	473320	488621	45
16	346390	362709	378918	395011	410984	426832	442550	458133	473576	488875	44
17	346663	362980	379187	395278	411249	427095	442810	458391	473832	489129	43
18	346936	363251	379456	395546	411514	427358	443071	458650	474088	489382	42
19	347208	363522	379725	395813	411779	427621	443332	458908	474344	489636	41
20	347481	363793	379994	396080	412045	427884	443593	459166	474600	489890	40
21	347754	364064	380263	396347	412310	428147	443853	459425	474856	490143	39
22	348027	364335	380532	396614	412575	428410	444114	459683	475112	490397	38
23	348299	364606	380801	396881	412840	428672	444375	459942	475368	490650	37
24	348572	364877	381070	397148	413104	428935	444635	460200	475624	490904	36
25	348845	365148	381339	397415	413369	429198	444896	460458	475880	491157	35
26	349117	365418	381608	397682	413634	429461	445156	460716	476136	491411	34
27	349390	365689	381877	397949	413899	429723	445417	460974	476392	491664	33
28	349662	365960	382146	398215	414164	429986	445677	461232	476647	491917	32
29	349935	366231	382415	398482	414429	430249	445937	461491	476903	492170	31
30	350207	366501	382683	398749	414693	430511	446198	461749	477159	492424	30
31	350480	366772	382952	399016	414958	430774	446458	462007	477414	492677	29
32	350752	367042	383221	399283	415223	431036	446718	462265	477670	492930	28
33	351025	367313	383490	399549	415487	431299	446979	462523	477925	493183	27
34	351297	367584	383758	399816	415752	431561	447239	462780	478181	493436	26
35	351569	367854	384027	400082	416016	431823	447499	463038	478436	493689	25
36	351842	368125	384295	400349	416281	432086	447759	463296	478692	493942	24
37	352114	368395	384564	400616	416545	432348	448019	463554	478947	494195	23
38	352386	368665	384832	400882	416810	432610	448279	463812	479203	494448	22
39	352658	368936	385101	401149	417074	432873	448539	464069	479458	494700	21
40	352931	369206	385369	401415	417338	433135	448799	464327	479713	494953	20
41	353203	369476	385638	401681	417603	433397	449059	464584	479968	495206	19
42	353475	369747	385906	401948	417867	433659	449319	464842	480223	495459	18
43	353747	370017	386174	402214	418131	433921	449579	465100	480479	495711	17
44	354019	370287	386443	402480	418396	434183	449839	465357	480734	495964	16
45	354291	370557	386711	402747	418660	434445	450098	465615	480989	496217	15
46	354563	370828	386979	403013	418924	434707	450358	465872	481244	496469	14
47	354835	371098	387247	403279	419188	434969	450618	466129	481499	496722	13
48	355107	371368	387516	403545	419452	435231	450878	466387	481754	496974	12
49	355379	371638	387784	403811	419716	435493	451137	466644	482009	497226	11
50	355651	371908	388052	404078	419980	435755	451397	466901	482263	497479	10
51	355923	372178	388320	404344	420244	436017	451656	467158	482518	497731	9
52	356194	372448	388588	404610	420508	436278	451916	467416	482773	497983	8
53	356466	372718	388856	404876	420772	436540	452175	467673	483028	498236	7
54	356738	372988	389124	405142	421036	436802	452435	467930	483282	498488	6
55	357010	373258	389392	405408	421300	437063	452694	468187	483537	498740	5
56	357281	373528	389660	405673	421563	437325	452953	468444	483792	498992	4
57	357553	373797	389928	405939	421827	437587	453213	468701	484046	499244	3
58	357825	374067	390196	406205	422091	437848	453472	468958	484301	499496	2
59	358096	374337	390463	406471	422355	438110	453731	469215	484555	499748	1
60	358368	374607	390731	406737	422618	438371	453990	469472	484810	500000	0
M	69°	68°	67°	66°	65°	64°	63°	62°	61°	60°	M

Natural Co-sines.

Diff. to 100″	454	451	448	445	441	438	434	430	426	422	

TABLE XXVI.—NATURAL SINES.

M	30°	31°	32°	33°	34°	35°	36°	37°	38°	39°	M
0	500000	515038	529919	544639	559193	573576	587785	601815	615661	629320	60
1	500252	515287	530166	544883	559434	573815	588021	602047	615891	629546	59
2	500504	515537	530413	545127	559675	574053	588256	602280	616120	629772	58
3	500756	515786	530659	545371	559916	574291	588491	602512	616349	629998	57
4	501007	516035	530906	545615	560157	574529	588726	602744	616578	630224	56
5	501259	516284	531152	545858	560398	574767	588961	602976	616807	630450	55
6	501511	516533	531399	546102	560639	575005	589196	603208	617036	630676	54
7	501762	516782	531645	546346	560880	575243	589431	603440	617265	630902	53
8	502014	517031	531891	546589	561121	575481	589666	603672	617494	631127	52
9	502266	517280	532138	546833	561361	575719	589901	603904	617722	631353	51
10	502517	517529	532384	547076	561602	575957	590136	604136	617951	631578	50
11	502769	517778	532630	547320	561843	576195	590371	604367	618180	631804	49
12	503020	518027	532876	547563	562083	576432	590606	604599	618408	632029	48
13	503271	518276	533122	547807	562324	576670	590840	604831	618637	632255	47
14	503523	518525	533368	548050	562564	576908	591075	605062	618865	632480	46
15	503774	518773	533615	548293	562805	577145	591310	605294	619094	632705	45
16	504025	519022	533861	548536	563045	577383	591544	605526	619322	632931	44
17	504276	519271	534106	548780	563286	577620	591779	605757	619551	633156	43
18	504528	519519	534352	549023	563526	577858	592013	605988	619779	633381	42
19	504779	519768	534598	549266	563766	578095	592248	606220	620007	633606	41
20	505030	520016	534844	549509	564007	578332	592482	606451	620235	633831	40
21	505281	520265	535090	549752	564247	578570	592716	606682	620464	634056	39
22	505532	520513	535335	549995	564487	578807	592951	606914	620692	634281	38
23	505783	520761	535581	550238	564727	579044	593185	607145	620920	634506	37
24	506034	521010	535827	550481	564967	579281	593419	607376	621148	634731	36
25	506285	521258	536072	550724	565207	579518	593653	607607	621376	634955	35
26	506535	521506	536318	550966	565447	579755	593887	607838	621604	635180	34
27	506786	521754	536563	551209	565687	579992	594121	608069	621831	635405	33
28	507037	522002	536809	551452	565927	580229	594355	608300	622059	635629	32
29	507288	522251	537054	551694	566166	580466	594589	608531	622287	635854	31
30	507538	522499	537300	551937	566406	580703	594823	608761	622515	636078	30
31	507789	522747	537545	552180	566646	580940	595057	608992	622742	636303	29
32	508040	522995	537790	552422	566886	581176	595290	609223	622970	636527	28
33	508290	523242	538035	552664	567125	581413	595524	609454	623197	636751	27
34	508541	523490	538281	552907	567365	581650	595758	609684	623425	636976	26
35	508791	523738	538526	553149	567604	581886	595991	609915	623652	637200	25
36	509041	523986	538771	553392	567844	582123	596225	610145	623880	637424	24
37	509292	524234	539016	553634	568083	582359	596458	610376	624107	637648	23
38	509542	524481	539261	553876	568323	582596	596692	610606	624334	637872	22
39	509792	524729	539506	554118	568562	582832	596925	610836	624561	638096	21
40	510043	524977	539751	554360	568801	583069	597159	611067	624789	638320	20
41	510293	525224	539996	554602	569040	583305	597392	611297	625016	638544	19
42	510543	525472	540240	554844	569280	583541	597625	611527	625243	638768	18
43	510793	525719	540485	555086	569519	583777	597858	611757	625470	638992	17
44	511043	525967	540730	555328	569758	584014	598092	611987	625697	639215	16
45	511293	526214	540974	555570	569997	584250	598325	612217	625923	639439	15
46	511543	526461	541219	555812	570236	584486	598558	612447	626150	639663	14
47	511793	526709	541464	556054	570475	584722	598791	612677	626377	639886	13
48	512043	526956	541708	556296	570714	584958	599024	612907	626604	640110	12
49	512293	527203	541953	556537	570952	585194	599256	613137	626830	640333	11
50	512543	527450	542197	556779	571191	585429	599489	613367	627057	640557	10
51	512792	527697	542442	557021	571430	585665	599722	613596	627284	640780	9
52	513042	527944	542686	557262	571669	585901	599955	613826	627510	641003	8
53	513292	528191	542930	557504	571907	586137	600188	614056	627737	641226	7
54	513541	528438	543174	557745	572146	586372	600420	614285	627963	641450	6
55	513791	528685	543419	557987	572384	586608	600653	614515	628189	641673	5
56	514040	528932	543663	558228	572623	586844	600885	614744	628416	641896	4
57	514290	529179	543907	558469	572861	587079	601118	614974	628642	642119	3
58	514539	529426	544151	558710	573100	587314	601350	615203	628868	642342	2
59	514789	529673	544395	558952	573338	587550	601583	615432	629094	642565	1
60	515038	529919	544639	559193	573576	587785	601815	615661	629320	642788	0
M	59°	58°	57°	56°	55°	54°	53°	52°	51°	50°	M

Natural Co-sines.

Diff. to 100″	418	413	409	404	399	394	390	385	380	374	

TABLE XXVI.—NATURAL SINES.

M	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	M
0	642788	656059	669131	681998	694658	707107	719340	731354	743145	754710	60
1	643010	656279	669347	682211	694868	707312	719542	731552	743339	754900	59
2	643233	656498	669563	682424	695077	707518	719744	731750	743534	755091	58
3	643456	656717	669779	682636	695286	707723	719946	731949	743728	755282	57
4	643679	656937	669995	682849	695495	707929	720148	732147	743923	755472	56
5	643901	657156	670211	683061	695704	708134	720349	732345	744117	755663	55
6	644124	657375	670427	683274	695913	708340	720551	732543	744312	755853	54
7	644346	657594	670642	683486	696122	708545	720753	732741	744506	756044	53
8	644569	657814	670858	683698	696330	708750	720954	732939	744700	756234	52
9	644791	658033	671074	683911	696539	708956	721156	733137	744894	756425	51
10	645013	658252	671289	684123	696748	709161	721357	733334	745088	756615	50
11	645236	658471	671505	684335	696957	709366	721559	733532	745282	756805	49
12	645458	658689	671721	684547	697165	709571	721760	733730	745476	756995	48
13	645680	658908	671936	684759	697374	709776	721962	733927	745670	757185	47
14	645902	659127	672151	684971	697582	709981	722163	734125	745864	757375	46
15	646124	659346	672367	685183	697790	710185	722364	734323	746057	757565	45
16	646346	659565	672582	685395	697999	710390	722565	734520	746251	757755	44
17	646568	659783	672797	685607	698207	710595	722766	734717	746445	757945	43
18	646790	660002	673013	685818	698415	710799	722967	734915	746638	758134	42
19	647012	660220	673228	686030	698623	711004	723168	735112	746832	758324	41
20	647233	660439	673443	686242	698832	711209	723369	735309	747025	758514	40
21	647455	660657	673658	686453	699040	711413	723570	735506	747218	758703	39
22	647677	660875	673873	686665	699248	711617	723771	735703	747412	758893	38
23	647898	661094	674088	686876	699455	711822	723971	735900	747605	759082	37
24	648120	661312	674302	687088	699663	712026	724172	736097	747798	759271	36
25	648341	661530	674517	687299	699871	712230	724372	736294	747991	759461	35
26	648563	661748	674732	687510	700079	712434	724573	736491	748184	759650	34
27	648784	661966	674947	687721	700287	712639	724773	736687	748377	759839	33
28	649006	662184	675161	687932	700494	712843	724974	736884	748570	760028	32
29	649227	662402	675376	688144	700702	713047	725174	737081	748763	760217	31
30	649448	662620	675590	688355	700909	713250	725374	737277	748956	760406	30
31	649669	662838	675805	688566	701117	713454	725575	737474	749148	760595	29
32	649890	663056	676019	688776	701324	713658	725775	737670	749341	760784	28
33	650111	663273	676233	688987	701531	713862	725975	737867	749534	760972	27
34	650332	663491	676448	689198	701739	714066	726175	738063	749726	761161	26
35	650553	663709	676662	689409	701946	714269	726375	738259	749919	761350	25
36	650774	663926	676876	689620	702153	714473	726575	738455	750111	761538	24
37	650995	664144	677090	689830	702360	714676	726775	738651	750303	761727	23
38	651216	664361	677304	690041	702567	714880	726974	738848	750496	761915	22
39	651437	664579	677518	690251	702774	715083	727174	739043	750688	762104	21
40	651657	664796	677732	690462	702981	715286	727374	739239	750880	762292	20
41	651878	665013	677946	690672	703188	715490	727573	739435	751072	762480	19
42	652098	665230	678160	690882	703395	715693	727773	739631	751264	762668	18
43	652319	665448	678373	691093	703601	715896	727972	739827	751456	762856	17
44	652539	665665	678587	691303	703808	716099	728172	740023	751648	763044	16
45	652760	665882	678801	691513	704015	716302	728371	740218	751840	763232	15
46	652980	666099	679014	691723	704221	716505	728570	740414	752032	763420	14
47	653200	666316	679228	691933	704428	716708	728769	740609	752223	763608	13
48	653421	666532	679441	692143	704634	716911	728969	740805	752415	763796	12
49	653641	666749	679655	692353	704841	717113	729168	741000	752606	763984	11
50	653861	666966	679868	692563	705047	717316	729367	741195	752798	764171	10
51	654081	667183	680081	692773	705253	717519	729566	741391	752989	764359	9
52	654301	667399	680295	692983	705459	717721	729765	741586	753181	764547	8
53	654521	667616	680508	693192	705665	717924	729963	741781	753372	764734	7
54	654741	667833	680721	693402	705872	718126	730162	741976	753563	764921	6
55	654961	668049	680934	693611	706078	718329	730361	742171	753755	765109	5
56	655180	668265	681147	693821	706284	718531	730560	742366	753946	765296	4
57	655400	668482	681360	694030	706489	718733	730758	742561	754137	765483	3
58	655620	668698	681573	694240	706695	718936	730957	742755	754328	765670	2
59	655839	668914	681786	694449	706901	719138	731155	742950	754519	765857	1
60	656059	669131	681998	694658	707107	719340	731354	743145	754710	766044	0
M	49°	48°	47°	46°	45°	44°	43°	42°	41°	40°	M

Natural Co-sines.

Diff. to 100″	369	363	357	352	346	340	334	327	321	315	

TABLE XXVI.- NATURAL SINES.

M	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°	M
0	766044	777146	788011	798636	809017	819152	829038	838671	848048	857167	60
1	766231	777329	788190	798811	809188	819319	829200	838829	848202	857317	59
2	766418	777512	788369	798985	809359	819486	829363	838987	848356	857467	58
3	766605	777695	788548	799160	809530	819652	829525	839146	848510	857616	57
4	766792	777878	788727	799335	809700	819819	829688	839304	848664	857766	56
5	766979	778060	788905	799510	809871	819985	829850	839462	848818	857915	55
6	767165	778243	789084	799685	810042	820152	830012	839620	848972	858065	54
7	767352	778426	789263	799859	810212	820318	830174	839778	849125	858214	53
8	767538	778608	789441	800034	810383	820485	830337	839936	849279	858364	52
9	767725	778791	789620	800208	810553	820651	830499	840094	849433	858513	51
10	767911	778973	789798	800383	810723	820817	830661	840251	849586	858662	50
11	768097	779156	789977	800557	810894	820983	830823	840409	849739	858811	49
12	768284	779338	790155	800731	811064	821149	830984	840567	849893	858960	48
13	768470	779520	790333	800906	811234	821315	831146	840724	850046	859109	47
14	768656	779702	790511	801080	811404	821481	831308	840882	850199	859258	46
15	768842	779884	790690	801254	811574	821647	831470	841039	850352	859406	45
16	769028	780067	790868	801428	811744	821813	831631	841196	850505	859555	44
17	769214	780249	791046	801602	811914	821978	831793	841354	850658	859704	43
18	769400	780430	791224	801776	812084	822144	831954	841511	850811	859852	42
19	769585	780612	791401	801949	812253	822310	832115	841668	850964	860001	41
20	769771	780794	791579	802123	812423	822475	832277	841825	851117	860149	40
21	769957	780976	791757	802297	812592	822641	832438	841982	851269	860297	39
22	770142	781157	791935	802470	812762	822806	832599	842139	851422	860446	38
23	770328	781339	792112	802644	812931	822971	832760	842296	851575	860594	37
24	770513	781520	792290	802817	813101	823136	832921	842452	851727	860742	36
25	770699	781702	792467	802991	813270	823302	833082	842609	851879	860890	35
26	770884	781883	792644	803164	813439	823467	833243	842766	852032	861038	34
27	771069	782065	792822	803337	813608	823632	833404	842922	852184	861186	33
28	771254	782246	792999	803511	813778	823797	833565	843079	852336	861334	32
29	771440	782427	793176	803684	813947	823961	833725	843235	852488	861481	31
30	771625	782608	793353	803857	814116	824126	833886	843391	852640	861629	30
31	771810	782789	793530	804030	814284	824291	834046	843548	852792	861777	29
32	771995	782970	793707	804203	814453	824456	834207	843704	852944	861924	28
33	772179	783151	793884	804376	814622	824620	834367	843860	853096	862072	27
34	772364	783332	794061	804548	814791	824785	834527	844016	853248	862219	26
35	772549	783513	794238	804721	814959	824949	834688	844172	853399	862366	25
36	772734	783693	794415	804894	815128	825113	834848	844328	853551	862514	24
37	772918	783874	794591	805066	815296	825278	835008	844484	853702	862661	23
38	773103	784055	794768	805239	815465	825442	835168	844640	853854	862808	22
39	773287	784235	794944	805411	815633	825606	835328	844795	854005	862955	21
40	773472	784416	795121	805584	815801	825770	835488	844951	854156	863102	20
41	773656	784596	795297	805756	815969	825934	835648	845106	854308	863249	19
42	773840	784776	795473	805928	816138	826098	835807	845262	854459	863396	18
43	774024	784957	795650	806100	816306	826262	835967	845417	854610	863542	17
44	774209	785137	795826	806271	816474	826426	836127	845573	854761	863689	16
45	774393	785317	796002	806443	816642	826590	836286	845728	854912	863836	15
46	774577	785497	796178	806614	816809	826753	836446	845883	855063	863982	14
47	774761	785677	796354	806788	816977	826917	836605	846038	855214	864128	13
48	774944	785857	796530	806960	817145	827081	836764	846193	855364	864275	12
49	775128	786037	796706	807132	817313	827244	836924	846348	855515	864421	11
50	775312	786217	796882	807301	817480	827407	837083	846503	855665	864567	10
51	775496	786396	797057	807475	817648	827571	837242	846658	855816	864713	9
52	775679	786576	797233	807647	817815	827734	837401	846813	855966	864860	8
53	775863	786756	797408	807818	817982	827897	837560	846967	856117	865006	7
54	776046	786935	797584	807990	818150	828060	837719	847122	856267	865151	6
55	776230	787114	797759	808161	818317	828223	837878	847277	856417	865297	5
56	776413	787294	797935	808333	818484	828386	838036	847431	856567	865443	4
57	776596	787473	798110	808504	818651	828549	838195	847585	856718	865589	3
58	776780	787652	798285	808675	818818	828712	838354	847740	856868	865734	2
59	776963	787832	798460	808846	818985	828875	838512	847894	857017	865880	1
60	777146	788011	798636	809017	819152	829038	838671	848048	857167	866025	0
M	39°	38°	37°	36°	35°	34°	33°	32°	31°	30°	M
Natural Co-sines.											
Diff. to 100″	309	302	295	288	282	275	268	260	253	246	

TABLE XXVI.—NATURAL SINES.

M	60°	61°	62°	63°	64°	65°	66°	67°	68°	69°	M
0	866025	874620	882948	891007	898794	906308	913545	920505	927184	933580	60
1	866171	874761	883084	891139	898922	906431	913664	920618	927293	933685	59
2	866316	874902	883221	891270	899049	906554	913782	920732	927402	933789	58
3	866461	875042	883357	891402	899176	906676	913900	920846	927510	933893	57
4	866607	875183	883493	891534	899304	906799	914018	920959	927619	933997	56
5	866752	875324	883629	891666	899431	906922	914136	921072	927728	934101	55
6	866897	875465	883766	891798	899558	907044	914254	921185	927836	934204	54
7	867042	875605	883902	891929	899685	907166	914372	921299	927945	934308	53
8	867187	875746	884038	892061	899812	907289	914490	921412	928053	934412	52
9	867331	875886	884174	892192	899939	907411	914607	921525	928161	934515	51
10	867476	876026	884309	892323	900065	907533	914725	921638	928270	934619	50
11	867621	876167	884445	892455	900192	907655	914842	921750	928378	934722	49
12	867765	876307	884581	892586	900319	907777	914960	921863	928486	934826	48
13	867910	876447	884717	892717	900445	907899	915077	921976	928594	934929	47
14	868054	876587	884852	892848	900572	908021	915194	922088	928702	935032	46
15	868199	876727	884988	892979	900698	908143	915311	922201	928810	935135	45
16	868343	876867	885123	893110	900825	908265	915429	922313	928917	935238	44
17	868487	877006	885258	893241	900951	908387	915546	922426	929025	935341	43
18	868632	877146	885394	893372	901077	908508	915663	922538	929133	935444	42
19	868776	877286	885529	893502	901203	908630	915779	922650	929240	935547	41
20	868920	877425	885664	893633	901329	908751	915896	922762	929348	935650	40
21	869064	877565	885799	893763	901455	908872	916013	922874	929455	935752	39
22	869207	877704	885934	893894	901581	908994	916130	922986	929562	935855	38
23	869351	877844	886069	894024	901707	909115	916246	923098	929669	935957	37
24	869495	877983	886204	894154	901833	909236	916363	923210	929776	936060	36
25	869639	878122	886338	894284	901958	909357	916479	923322	929884	936162	35
26	869782	878261	886473	894415	902084	909478	916595	923434	929990	936264	34
27	869926	878400	886608	894545	902209	909599	916712	923545	930097	936366	33
28	870069	878539	886742	894675	902335	909720	916828	923657	930204	936468	32
29	870212	878678	886876	894805	902460	909841	916944	923768	930311	936570	31
30	870356	878817	887011	894934	902585	909961	917060	923880	930418	936672	30
31	870499	878956	887145	895064	902710	910082	917176	923991	930524	936774	29
32	870642	879095	887279	895194	902836	910202	917292	924102	930631	936876	28
33	870785	879233	887413	895323	902961	910323	917408	924213	930737	936977	27
34	870928	879372	887548	895453	903086	910443	917523	924324	930843	937079	26
35	871071	879510	887681	895582	903210	910563	917639	924435	930950	937181	25
36	871214	879649	887815	895712	903335	910684	917755	924546	931056	937282	24
37	871357	879787	887949	895841	903460	910804	917870	924657	931162	937383	23
38	871499	879925	888083	895970	903585	910924	917986	924768	931268	937485	22
39	871642	880063	888217	896099	903709	911044	918101	924878	931374	937586	21
40	871784	880201	888350	896229	903834	911164	918216	924989	931480	937687	20
41	871927	880339	888484	896358	903958	911284	918331	925099	931586	937788	19
42	872069	880477	888617	896486	904083	911403	918446	925210	931691	937889	18
43	872212	880615	888751	896615	904207	911523	918561	925320	931797	937990	17
44	872354	880753	888884	896744	904331	911643	918676	925430	931902	938091	16
45	872496	880891	889017	896873	904455	911762	918791	925541	932008	938191	15
46	872638	881028	889150	897001	904579	911881	918906	925651	932113	938292	14
47	872780	881166	889283	897130	904703	912001	919021	925761	932219	938393	13
48	872922	881303	889416	897258	904827	912120	919135	925871	932324	938493	12
49	873064	881441	889549	897387	904951	912239	919250	925980	932429	938593	11
50	873206	881578	889682	897515	905075	912358	919364	926090	932534	938694	10
51	873347	881716	889815	897643	905198	912477	919479	926200	932639	938794	9
52	873489	881853	889948	897771	905322	912596	919593	926310	932744	938894	8
53	873631	881990	890080	897900	905445	912715	919707	926419	932849	938994	7
54	873772	882127	890213	898028	905569	912834	919821	926529	932954	939094	6
55	873914	882264	890345	898156	905692	912953	919936	926638	933058	939194	5
56	874055	882401	890478	898283	905815	913072	920050	926747	933163	939294	4
57	874196	882538	890610	898411	905939	913190	920164	926857	933267	939394	3
58	874338	882674	890742	898539	906062	913309	920277	926966	933372	939493	2
59	874479	882811	890874	898666	906185	913427	920391	927075	933476	939593	1
60	874620	882948	891007	898794	906308	913545	920505	927184	933580	939693	0
M	29°	28°	27°	26°	25°	24°	23°	22°	21°	20°	M

Natural Co-sines.

Diff. to 100″	239	231	224	216	209	201	193	185	178	170

TABLE XXVI.—NATURAL SINES.

M	70°	71°	72°	73°	74°	75°	76°	77°	78°	79°	M
0	939693	945519	951057	956305	961262	965926	970296	974370	978148	981627	60
1	939792	945613	951146	956390	961342	966001	970366	974435	978208	981683	59
2	939891	945708	951236	956475	961422	966076	970436	974501	978268	981738	58
3	939991	945802	951326	956560	961502	966151	970506	974566	978329	981793	57
4	940090	945897	951415	956644	961582	966226	970577	974631	978389	981849	56
5	940189	945991	951505	956729	961662	966301	970647	974696	978449	981904	55
6	940288	946085	951594	956814	961741	966376	970716	974761	978509	981959	54
7	940387	946180	951684	956898	961821	966451	970786	974826	978569	982014	53
8	940486	946274	951773	956983	961901	966526	970856	974891	978629	982069	52
9	940585	946368	951862	957067	961980	966600	970926	974956	978689	982123	51
10	940684	946462	951951	957151	962059	966675	970995	975020	978748	982178	50
11	940782	946555	952040	957235	962139	966749	971065	975085	978808	982233	49
12	940881	946649	952129	957319	962218	966823	971134	975149	978867	982287	48
13	940979	946743	952218	957404	962297	966898	971204	975214	978927	982342	47
14	941078	946837	952307	957487	962376	966972	971273	975278	978986	982396	46
15	941176	946930	952396	957571	962455	967046	971342	975342	979045	982450	45
16	941274	947024	952484	957655	962534	967120	971411	975406	979105	982505	44
17	941372	947117	952573	957739	962613	967194	971480	975471	979164	982559	43
18	941471	947210	952661	957822	962692	967268	971549	975535	979223	982613	42
19	941569	947304	952750	957906	962770	967342	971618	975598	979282	982667	41
20	941666	947397	952838	957990	962849	967415	971687	975662	979341	982721	40
21	941764	947490	952926	958073	962928	967489	971755	975726	979399	982774	39
22	941862	947583	953015	958156	963006	967562	971824	975790	979458	982828	38
23	941960	947676	953103	958239	963084	967636	971893	975853	979517	982882	37
24	942057	947768	953191	958323	963163	967709	971961	975917	979575	982935	36
25	942155	947861	953279	958406	963241	967782	972030	975980	979634	982989	35
26	942252	947954	953366	958489	963319	967856	972098	976044	979692	983042	34
27	942350	948046	953454	958572	963397	967929	972166	976107	979750	983096	33
28	942447	948139	953542	958654	963475	968002	972234	976170	979809	983149	32
29	942544	948231	953629	958737	963553	968075	972302	976233	979867	983202	31
30	942641	948324	953717	958820	963630	968148	972370	976296	979925	983255	30
31	942739	948416	953804	958902	963708	968220	972438	976359	979983	983308	29
32	942836	948508	953892	958985	963786	968293	972506	976422	980041	983361	28
33	942932	948600	953979	959067	963863	968366	972573	976485	980098	983414	27
34	943029	948692	954066	959150	963941	968438	972641	976547	980156	983466	26
35	943126	948784	954153	959232	964018	968511	972708	976610	980214	983519	25
36	943223	948876	954240	959314	964095	968583	972776	976672	980271	983571	24
37	943319	948968	954327	959396	964173	968656	972843	976735	980329	983624	23
38	943416	949059	954414	959478	964250	968728	972911	976797	980386	983676	22
39	943512	949151	954501	959560	964327	968800	972978	976859	980443	983729	21
40	943609	949243	954588	959642	964404	968872	973045	976921	980500	983781	20
41	943705	949334	954674	959724	964481	968944	973112	976984	980558	983833	19
42	943801	949425	954761	959805	964557	969016	973179	977046	980615	983885	18
43	943897	949517	954847	959887	964634	969088	973246	977108	980672	983937	17
44	943993	949608	954934	959968	964711	969159	973313	977169	980728	983989	16
45	944089	949699	955020	960050	964787	969231	973379	977231	980785	984041	15
46	944185	949790	955106	960131	964864	969302	973446	977293	980842	984092	14
47	944281	949881	955192	960212	964940	969374	973512	977354	980899	984144	13
48	944376	949972	955278	960294	965016	969445	973579	977416	980955	984196	12
49	944472	950063	955364	960375	965093	969517	973645	977477	981012	984247	11
50	944568	950154	955450	960456	965169	969588	973712	977539	981068	984298	10
51	944663	950244	955536	960537	965245	969659	973778	977600	981124	984350	9
52	944758	950335	955622	960618	965321	969730	973844	977661	981181	984401	8
53	944854	950425	955707	960698	965397	969801	973910	977722	981237	984452	7
54	944949	950516	955793	960779	965473	969872	973976	977783	981293	984503	6
55	945044	950606	955879	960860	965548	969943	974042	977844	981349	984554	5
56	945139	950696	955964	960940	965624	970014	974108	977905	981405	984605	4
57	945234	950780	956049	961021	965700	970084	974173	977966	981460	984656	3
58	945329	950877	956134	961101	965775	970155	974239	978026	981516	984707	2
59	945424	950967	956220	961181	965850	970225	974305	978087	981572	984757	1
60	945519	951057	956305	961262	965926	970296	974370	978148	981627	984808	0
M	19°	18°	17°	16°	15°	14°	13°	12°	11°	10°	M

Natural Co-sines.

Diff. to 100″	162	154	146	138	130	121	113	105	97	88	

TABLE XXVI.—NATURAL SINES.

M	80°	81°	82°	83°	84°	85°	86°	87°	88°	89°	M
0	984808	987688	990268	992546	994522	996195	997564	998630	999391	999848	60
1	984858	987734	990309	992582	994552	996220	997584	998645	999401	999853	59
2	984909	987779	990349	992617	994583	996245	997604	998660	999411	999858	58
3	984959	987824	990389	992652	994613	996270	997625	998675	999421	999863	57
4	985009	987870	990429	992687	994643	996295	997645	998690	999431	999867	56
5	985059	987915	990469	992722	994673	996320	997664	998705	999441	999872	55
6	985109	987960	990509	992757	994703	996345	997684	998719	999450	999877	54
7	985159	988005	990549	992792	994733	996370	997704	998734	999460	999881	53
8	985209	988050	990589	992827	994762	996395	997724	998749	999469	999886	52
9	985259	988094	990629	992862	994792	996419	997743	998763	999479	999890	51
10	985309	988139	990669	992896	994822	996444	997763	998778	999488	999894	50
11	985358	988184	990708	992931	994851	996468	997782	998792	999497	999898	49
12	985408	988228	990748	992966	994881	996493	997801	998806	999507	999903	48
13	985457	988273	990787	993000	994910	996517	997821	998820	999516	999907	47
14	985507	988317	990827	993034	994939	996541	997840	998834	999525	999910	46
15	985556	988362	990866	993068	994969	996566	997859	998848	999534	999914	45
16	985605	988406	990905	993103	994998	996589	997878	998862	999542	999918	44
17	985654	988450	990944	993137	995027	996614	997897	998876	999551	999922	43
18	985703	988494	990983	993171	995056	996637	997916	998890	999560	999925	42
19	985752	988538	991022	993205	995084	996661	997934	998904	999568	999929	41
20	985801	988582	991061	993238	995113	996685	997953	998917	999577	999932	40
21	985850	988626	991100	993272	995142	996709	997972	998931	999585	999936	39
22	985899	988669	991138	993306	995170	996732	997990	998944	999594	999939	38
23	985947	988713	991177	993339	995199	996756	998008	998957	999602	999942	37
24	985996	988756	991216	993373	995227	996779	998027	998971	999610	999945	36
25	986045	988800	991254	993406	995256	996802	998045	998984	999618	999948	35
26	986093	988843	991292	993439	995284	996825	998063	998997	999626	999951	34
27	986141	988886	991331	993473	995312	996848	998081	999010	999634	999954	33
28	986189	988930	991369	993506	995340	996872	998099	999023	999642	999957	32
29	986238	988973	991407	993539	995368	996894	998117	999035	999650	999959	31
30	986286	989016	991445	993572	995396	996917	998135	999048	999657	999962	30
31	986334	989059	991483	993605	995424	996940	998153	999061	999665	999964	29
32	986381	989102	991521	993638	995452	996963	998170	999073	999672	999967	28
33	986429	989145	991558	993670	995479	996985	998188	999086	999680	999969	27
34	986477	989187	991596	993703	995507	997008	998205	999098	999687	999971	26
35	986525	989230	991634	993735	995535	997030	998223	999111	999694	999974	25
36	986572	989272	991671	993768	995562	997053	998240	999123	999701	999976	24
37	986620	989315	991709	993800	995589	997075	998257	999135	999709	999978	23
38	986667	989357	991746	993833	995617	997097	998274	999147	999716	999980	22
39	986714	989399	991783	993865	995644	997119	998291	999159	999722	999981	21
40	986762	989442	991820	993897	995671	997141	998308	999171	999729	999983	20
41	986809	989484	991857	993929	995698	997163	998325	999183	999736	999985	19
42	986856	989526	991894	993961	995725	997185	998342	999194	999743	999986	18
43	986903	989568	991931	993993	995752	997207	998359	999206	999749	999988	17
44	986950	989610	991968	994025	995778	997229	998375	999218	999756	999989	16
45	986996	989651	992005	994056	995805	997250	998392	999229	999762	999990	15
46	987043	989693	992042	994088	995832	997272	998408	999240	999768	999992	14
47	987090	989735	992078	994120	995858	997293	998425	999252	999775	999993	13
48	987136	989776	992115	994151	995884	997314	998441	999263	999781	999994	12
49	987183	989818	992151	994182	995911	997336	998457	999274	999787	999995	11
50	987229	989859	992187	994214	995937	997357	998473	999285	999793	999996	10
51	987275	989900	992224	994245	995963	997378	998489	999296	999799	999997	9
52	987322	989942	992260	994276	995989	997399	998505	999307	999804	999997	8
53	987368	989983	992296	994307	996015	997420	998521	999318	999810	999998	7
54	987414	990024	992332	994338	996041	997441	998537	999328	999816	999998	6
55	987460	990065	992368	994369	996067	997462	998552	999339	999821	999999	5
56	987506	990105	992404	994400	996093	997482	998568	999350	999827	999999	4
57	987551	990146	992439	994430	996118	997503	998583	999360	999832	1000000	3
58	987597	990187	992475	994461	996144	997523	998599	999370	999837	1000000	2
59	987643	990228	992511	994491	996169	997544	998614	999381	999843	1000000	1
60	987688	990268	992546	994522	996195	997564	998630	999391	999848	1000000	0
M	9°	8°	7°	6°	5°	4°	3°	2°	1°	0°	M

Natural Co-sines.

Diff. to 100″	80	72	63	55	47	38	30	21	13	4	Y

TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

HALF ELAPSED TIME.

0 Hour.

M	0^{s}	5^{s}	10^{s}	15^{s}	20^{s}	25^{s}	30^{s}	35^{s}	40^{s}	45^{s}	50^{s}	55^{s}	Pro. pts.
0		43936	13833	96224	83730	74039	66121	59427	53628	48512	43937	39797	
1	2.36018	32542	29324	26328	23525	20892	18410	16061	13834	11715	09695	07764	
2	05916	04143	02440	00801	99221	97697	96225	94801	93422	92086	90790	89531	
3	1.88307	87118	85959	84831	83732	82660	81613	80591	79593	78617	77663	76729	
4	75815	74919	74042	73182	72339	71512	70700	69903	69121	68352	67597	66855	
5	66125	65407	64701	64006	63322	62649	61986	61333	60690	60056	59431	58815	
6	58208	57609	57019	56436	55861	55293	54733	54180	53634	53094	52561	52035	
7	51515	51001	50494	49992	49496	49005	48520	48040	47566	47096	46632	46173	
8	45718	45268	44823	44382	43946	43514	43086	42663	42243	41828	41417	41009	
9	40605	40205	39809	39416	39027	38641	38258	37879	37504	37131	36762	36395	
10	1.36032	35672	35315	34960	34609	34260	33915	33572	33231	32893	32558	32226	s 300
11	31896	31568	31243	30921	30600	30282	29967	29653	29342	29034	28727	28422	1 60
12	28120	27820	27522	27225	26931	26639	26349	26061	25774	25490	25207	24926	2 120
13	24647	24370	24095	23821	23549	23279	23010	22743	22478	22214	21952	21691	3 180
14	21433	21175	20919	20665	20412	20160	19910	19662	19415	19169	18925	18682	4 240
15	18440	18200	17961	17723	17487	17252	17018	16786	16554	16324	16096	15868	s 210
16	15642	15416	15192	14969	14748	14527	14307	14089	13872	13656	13440	13226	1 42
17	13013	12801	12590	12380	12172	11964	11757	11551	11346	11142	10939	10737	2 84
18	10536	10236	10136	09938	09741	09544	09348	09154	08960	08767	08574	08383	3 126
19	08193	08003	07814	07626	07439	07253	07067	06883	06699	06515	06333	06151	4 168
20	1.05970	05790	05611	05432	05254	05077	04901	04725	04550	04376	04202	04029	s 162
21	03857	03686	03515	03345	03175	03006	02838	02671	02504	02338	02172	02007	1 32
22	01843	01679	01516	01354	01192	01030	00870	00710	00550	00392	00233	00076	2 65
23	0.99918	99762	99606	99451	99296	99141	98988	98834	98682	98530	98378	98227	3 97
24	98077	97927	97777	97628	97480	97332	97184	97038	96891	96745	96600	96455	4 130
25	96310	96167	96023	95880	95738	95596	95454	95313	95172	95032	94892	94753	s 132
26	94614	94476	94338	94200	94063	93927	93791	93655	93519	93385	93250	93116	1 26
27	92982	92849	92716	92584	92452	92320	92189	92059	91928	91798	91669	91539	2 53
28	91411	91282	91154	91027	90899	90772	90646	90520	90394	90268	90143	90019	3 79
29	89894	89771	89647	89524	89401	89278	89156	89034	88913	88792	88671	88550	4 106
30	0.88430	88311	88191	88072	87953	87835	87717	87599	87481	87364	87247	87131	s 111
31	87015	86899	86783	86668	86553	86438	86324	86210	86096	85983	85870	85757	1 22
32	85645	85532	85420	85309	85197	85086	84976	84865	84755	84645	84535	84426	2 44
33	84317	84208	84100	83992	83884	83776	83669	83561	83455	83348	83242	83136	3 67
34	83030	82924	82819	82714	82609	82505	82401	82297	82193	82089	81986	81883	4 89
35	81780	81678	81576	81474	81372	81271	81169	81068	80968	80867	80767	80667	s 96
36	80567	80467	80368	80269	80170	80071	79973	79875	79777	79679	79581	79484	1 19
37	79387	79290	79193	79097	79001	78905	78809	78714	78618	78523	78428	78334	2 38
38	78239	78145	78051	77957	77863	77770	77677	77584	77491	77398	77306	77214	3 57
39	77122	77030	76938	76847	76756	76665	76574	76483	70393	76303	76213	76123	4 77
40	0.76033	75944	75854	75765	75676	75588	75499	75411	75323	75235	75147	75059	s 85
41	74972	74885	74798	74711	74624	74537	74451	74365	74279	74193	74108	74022	1 17
42	73937	73852	73767	73682	73597	73513	73429	73345	73261	73177	73093	73010	2 34
43	72927	72843	72761	72678	72595	72513	72430	72348	72266	72185	72103	72021	3 51
44	71940	71859	71778	71697	71616	71536	71456	71375	71295	71215	71136	71056	4 68
45	70976	70897	70818	70739	70660	70581	70503	70424	70346	70268	70 90	70112	s 75
46	70035	69957	69880	69802	69725	69648	69571	69495	69418	69342	69265	69189	1 15
47	69113	69038	68962	68886	68811	68735	68660	68585	68510	68436	68361	68287	2 30
48	68212	68138	68064	67990	67916	67842	67769	67695	67622	67549	67476	67403	3 45
49	67330	67257	67185	67112	67040	66968	66896	66824	66752	66681	66609	66538	4 60
50	0.66466	66395	66324	66253	66182	66112	66041	65971	65900	65830	65760	65690	s 68
51	65620	65551	65481	65411	65342	65273	65204	65135	65066	64997	64928	64860	1 14
52	64791	64723	64655	64587	64519	64451	64383	64315	64248	64180	64113	64046	2 27
53	63979	63912	63845	63778	63711	63645	63578	63512	63445	63379	63313	63247	3 41
54	63182	63116	63050	62985	62919	62854	62789	62724	62659	62594	62529	62464	4 54
55	62400	62335	62271	62207	62142	62078	62014	61950	61887	61823	61759	61696	s 62
56	61633	61569	61506	61443	61380	61317	61254	61192	61129	61066	61004	60942	1 12
57	60879	60817	60755	60693	60632	60570	60508	60447	60385	60324	60262	60201	2 25
58	60140	60079	60018	59957	59897	59836	59775	59715	59655	59594	59534	59474	3 37
59	59414	59354	59294	59234	59175	59115	59056	58996	58937	58878	58818	58759	4 50

TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

HALF ELAPSED TIME.

1 Hour.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.
0	0.58700	58642	58583	58524	58465	58407	58348	58290	58232	58173	58115	58057	s 56
1	57999	57941	57884	57826	57768	57711	57653	57596	57539	57481	57424	57367	1 11
2	57310	57253	57196	57140	57083	57026	56970	56914	56857	56801	56745	56689	2 22
3	56633	56577	56521	56465	56409	56354	56298	56243	56187	56132	56077	56021	3 34
4	55966	55911	55856	55801	55747	55692	55637	55583	55528	55474	55419	55365	4 45
5	55311	55257	55203	55149	55095	55041	54987	54933	54880	54826	54773	54719	s 52
6	54666	54613	54559	54506	54453	54400	54347	54294	54242	54189	54136	54084	1 10
7	54031	53979	53926	53874	53822	53770	53718	53666	53614	53562	53510	53458	2 21
8	53407	53355	53303	53252	53200	53149	53098	53047	52995	52944	52893	52842	3 31
9	52791	52741	52690	52639	52589	52538	52488	52437	52387	52336	52286	52236	4 42
10	0.52186	52136	52086	52036	51986	51936	51887	51837	51787	51738	51688	51639	s 48
11	51589	51540	51491	51442	51393	51344	51295	51246	51197	51148	51099	51050	1 10
12	51002	50953	50905	50856	50808	50760	50711	50663	50615	50567	50519	50471	2 19
13	50423	50375	50327	50279	50232	50184	50137	50089	50042	49994	49947	49900	3 29
14	49852	49805	49758	49711	49664	49617	49570	49523	49477	49430	49383	49337	4 38
15	49290	49244	49197	49151	49104	49058	49012	48966	48920	48874	48828	48782	s 45
16	48736	48690	48644	48599	48553	48507	48462	48416	48371	48325	48280	48235	1 9
17	48189	48144	48099	48054	48009	47964	47919	47874	47829	47785	47740	47695	2 18
18	47651	47606	47561	47517	47473	47428	47384	47340	47295	47251	47207	47163	3 27
19	47119	47075	47031	46987	46944	46900	46856	46812	46769	46725	46682	46638	4 36
20	0.46595	46552	46508	46465	46422	46379	46335	46292	46249	46206	46163	46121	s 42
21	46078	46035	45992	45950	45907	45864	45822	45779	45737	45694	45652	45610	1 8
22	45568	45525	45483	45441	45399	45357	45315	45273	45231	45189	45147	45106	2 17
23	45064	45022	44981	44939	44898	44856	44815	44773	44732	44691	44650	44608	3 25
24	44567	44526	44485	44444	44403	44362	44321	44280	44239	44199	44158	44117	4 34
25	44077	44036	43996	43955	43915	43874	43834	43793	43753	43713	43673	43633	s 40
26	43593	43552	43512	43472	43432	43393	43353	43313	43273	43233	43194	43154	1 8
27	43115	43075	43035	42996	42957	42917	42878	42838	42799	42760	42721	42682	2 16
28	42643	42603	42564	42525	42486	42448	42409	42370	42331	42292	42254	42215	3 24
29	42176	42138	42099	42061	42022	41984	41946	41907	41869	41831	41792	41754	4 32
30	0.41716	41678	41640	41602	41564	41526	41488	41450	41412	41375	41337	41299	37
31	41261	41224	41186	41149	41111	41074	41036	40999	40961	40924	40887	40849	1 7
32	40812	40775	40738	40701	40664	40627	40590	40553	40516	40479	40442	40405	2 15
33	40369	40332	40295	40258	40222	40185	40149	40112	40076	40039	40003	39966	3 22
34	39930	39894	39858	39821	39785	39749	39713	39677	39641	39605	39569	39533	4 30
35	39497	39461	39425	39389	39354	39318	39282	39247	39211	39175	39140	39104	s 35
36	39069	39033	38998	38962	38927	38892	38857	38821	38786	38751	38716	38681	1 7
37	38646	38611	38576	38541	38506	38471	38436	38401	38366	38331	38297	38262	2 14
38	38227	38193	38158	38124	38089	38055	38020	37986	37951	37917	37883	37848	3 21
39	37814	37780	37745	37711	37677	37643	37609	37575	37541	37507	37473	37439	4 28
40	0.37405	37371	37338	37304	37270	37236	37203	37169	37135	37102	37068	37035	s 33
41	37001	36968	36934	36901	36867	36834	36801	36768	36734	36701	36668	36635	1 7
42	36602	36569	36535	36502	36469	36436	36404	36371	36338	36305	36272	36239	2 13
43	36207	36174	36141	36108	36076	36043	36011	35978	35946	35913	35881	35848	3 20
44	35816	35783	35751	35719	35687	35654	35622	35590	35558	35526	35494	35462	4 26
45	35429	35397	35365	35334	35302	35270	35238	35206	35174	35142	35111	35079	s 31
46	35047	35016	34984	34952	34921	34889	34858	34826	34795	34763	34732	34701	1 6
47	34669	34638	34607	34575	34544	34513	34482	34451	34420	34388	34357	34326	2 12
48	34295	34264	34233	34203	34172	34141	34110	34079	34048	34018	33987	33956	3 19
49	33925	33895	33864	33834	33803	33773	33742	33712	33681	33651	33620	33590	4 25
50	0.33559	33529	33499	33469	33438	33408	33378	33348	33318	33288	33257	33227	s 30
51	33197	33167	33137	33107	33078	33048	33018	32988	32958	32928	32899	32869	1 6
52	32839	32809	32780	32750	32721	32691	32661	32632	32602	32573	32543	32514	2 12
53	32485	32455	32426	32397	32367	32338	32309	32280	32250	32221	32192	32163	3 18
54	32134	32105	32076	32047	32018	31989	31960	31931	31902	31873	31844	31815	4 24
55	31787	31758	31729	31700	31672	31643	31614	31586	31557	31529	31500	31471	s 29
56	31443	31414	31386	31358	31329	31301	31272	31244	31216	31188	31159	31131	1 6
57	31103	31075	31046	31018	30990	30962	30934	30906	30878	30850	30822	30794	2 12
58	30766	30738	30710	30683	30655	30627	30599	30571	30544	30516	30488	30461	3 7
59	30433	30405	30378	30350	30323	30295	30268	30240	30213	30185	30158	30130	4 23

TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

HALF ELAPSED TIME.

2 Hours.

M	0ˢ	5ˢ	10ˢ	15ˢ	20ˢ	25ˢ	30ˢ	35ˢ	40ˢ	45ˢ	50ˢ	55ˢ	Pro. pts.	
0	0.30103	30076	30048	30021	29994	29967	29939	29912	29885	29858	29831	29804	s	26
1	29776	29749	29722	29695	29668	29641	29614	29587	29561	29534	29507	29480	1	5
2	29453	29426	29400	29373	29346	29319	29293	29266	29239	29213	29186	29160	2	10
3	29133	29107	29080	29054	29027	29001	28974	28948	28921	28895	28869	28842	3	16
4	28816	28790	28764	28737	28711	28685	28659	28633	28607	28580	28554	28528	4	21
5	28502	28476	28450	28424	28398	28372	28347	28321	28295	28269	28243	28217	s	25
6	28192	28166	28140	28114	28089	28063	28037	28012	27986	27960	27935	27909	1	5
7	27884	27858	27833	27807	27782	27756	27731	27706	27680	27655	27630	27604	2	10
8	27579	27554	27529	27503	27478	27453	27428	27403	27378	27352	27327	27302	3	15
9	27277	27252	27227	27202	27177	27152	27127	27103	27078	27053	27028	27003	4	20
10	0.26978	26954	26929	26904	26879	26855	26830	26805	26781	26756	26732	26707	s	24
11	26682	26658	26633	26609	26584	26560	26535	26511	26487	26462	26438	26414	1	5
12	26389	26365	26341	26316	26292	26268	26244	26219	26195	26171	26147	26123	2	10
13	26099	26075	26051	26027	26003	25979	25955	25931	25907	25883	25859	25835	3	14
14	25811	25787	25763	25740	25716	25692	25668	25645	25621	25597	25573	25550	4	19
15	25526	25503	25479	25455	25432	25408	25385	25361	25338	25314	25291	25267	s	23
16	25244	25220	25197	25174	25150	25127	25104	25080	25057	25034	25011	24987	1	5
17	24964	24941	24918	24895	24872	24849	24825	24802	24779	24756	24733	24710	2	9
18	24687	24664	24641	24618	24595	24573	24550	24527	24504	24481	24458	24436	3	14
19	24413	24390	24367	24345	24322	24299	24277	24254	24231	24209	24186	24163	4	18
20	0.24141	24118	24096	24073	24051	24028	24006	23983	23961	23939	23916	23894	s	22
21	23872	23849	23827	23805	23782	23760	23738	23716	23693	23671	23649	23627	1	4
22	23605	23583	23560	23538	23516	23494	23472	23450	23428	23406	23384	23362	2	9
23	23340	23318	23296	23274	23253	23231	23209	23187	23165	23143	23122	23100	3	13
24	23078	23056	23035	23013	22991	22970	22948	22926	22905	22883	22862	22840	4	18
25	22819	22797	22776	22754	22733	22711	22690	22668	22647	22625	22604	22583	s	21
26	22561	22540	22519	22497	22476	22455	22434	22412	22391	22370	22349	22328	1	4
27	22306	22285	22264	22243	22222	22201	22180	22159	22138	22117	22096	22075	2	8
28	22054	22033	22012	21991	21970	21949	21928	21907	21887	21866	21845	21824	3	13
29	21803	21783	21762	21741	21720	21700	21679	21658	21638	21617	21597	21576	4	17
30	0.21555	21535	21514	21494	21473	21453	21432	21412	21391	21371	21350	21330	s	20
31	21309	21289	21269	21248	21228	21208	21187	21167	21147	21127	21106	21086	1	4
32	21066	21046	21025	21005	20985	20965	20945	20925	20905	20885	20864	20844	2	8
33	20824	20804	20784	20764	20744	20724	20704	20685	20665	20645	20625	20605	3	12
34	20585	20565	20545	20526	20506	20486	20466	20446	20427	20407	20387	20368	4	16
35	20348	20328	20309	20289	20269	20250	20230	20211	20191	20171	20152	20132	s	19
36	20113	20093	20074	20054	20035	20016	19996	19977	19957	19938	19919	19899	1	4
37	19880	19861	19841	19822	19803	19783	19764	19745	19726	19707	19687	19668	2	8
38	19649	19630	19611	19592	19572	19553	19534	19515	19496	19477	19458	19439	3	11
39	19420	19401	19382	19363	19344	19325	19306	19288	19269	19250	19231	19212	4	15
40	0.19193	19174	19156	19137	19118	19099	19081	19062	19043	19024	19006	18987	s	18
41	18968	18950	18931	18913	18894	18875	18857	18838	18820	18801	18783	18764	1	4
42	18746	18727	18709	18690	18672	18653	18635	18617	18598	18580	18561	18543	2	7
43	18525	18506	18488	18470	18452	18433	18415	18397	18379	18360	18342	18324	3	11
44	18306	18288	18269	18251	18233	18215	18197	18179	18161	18143	18125	18107	4	14
45	18089	18071	18053	18035	18017	17999	17981	17963	17945	17927	17909	17891	s	18
46	17874	17856	17838	17820	17802	17785	17767	17749	17731	17713	17696	17678	1	4
47	17660	17643	17625	17607	17590	17572	17554	17537	17519	17502	17484	17467	2	7
48	17449	17431	17414	17396	17379	17361	17344	17327	17309	17292	17274	17257	3	11
49	17239	17222	17205	17187	17170	17153	17135	17118	17101	17083	17066	17049	4	14
50	0.17032	17014	16997	16980	16963	16946	16929	16911	16894	16877	16860	16843	s	17
51	16826	16809	16792	16775	16758	16741	16724	16707	16690	16673	16656	16639	1	3
52	16622	16605	16588	16571	16554	16537	16520	16503	16487	16470	16453	16436	2	7
53	16419	16403	16386	16369	16352	16336	16319	16302	16285	16269	16252	16235	3	10
54	16219	16202	16186	16169	16152	16136	16119	16103	16086	16070	16053	16037	4	14
55	16020	16004	15987	15971	15954	15938	15921	15905	15888	15872	15856	15839	s	16
56	15823	15807	15790	15774	15758	15741	15725	15709	15692	15676	15660	15644	1	3
57	15628	15611	15595	15579	15563	15547	15531	15514	15498	15482	15466	15450	2	6
58	15434	15418	15402	15386	15370	15354	15338	15322	15306	15290	15274	15258	3	10
59	15242	15226	15210	15194	15178	15162	15147	15131	15115	15099	15083	15067	4	13

TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

HALF ELAPSED TIME.

3 Hours.

M	0^s	5^s	10^s	15^s	20^s	25^s	30^s	35^s	40^s	45^s	50^s	55^s	Pro. pts.	
0	0.15052	15036	15020	15004	14988	14973	14957	14941	14926	14910	14894	14879	s	16
1	14863	14847	14832	14816	14800	14785	14769	14754	14738	14722	14707	14691	1	3
2	14676	14660	14645	14629	14614	14598	14583	14567	14552	14537	14521	14506	2	6
3	14490	14475	14460	14444	14429	14414	14398	14383	14368	14352	14337	14322	3	10
4	14307	14291	14276	14261	14246	14231	14215	14200	14185	14170	14155	14140	4	13
5	14124	14109	14094	14079	14064	14049	14034	14019	14004	13989	13974	13959	s	15
6	13944	13929	13914	13899	13884	13869	13854	13839	13824	13809	13795	13780	1	3
7	13765	13750	13735	13720	13705	13691	13676	13661	13646	13632	13617	13602	2	6
8	13587	13573	13558	13543	13528	13514	13499	13484	13470	13455	13441	13426	3	9
9	13411	13397	13382	13368	13353	13339	13324	13309	13295	13280	13266	13251	4	12
10	0.13237	13223	13208	13194	13179	13165	13150	13136	13122	13107	13093	13078	s	14
11	13064	13050	13035	13021	13007	12992	12978	12964	12950	12935	12921	12907	1	3
12	12893	12878	12864	12850	12836	12822	12808	12793	12779	12765	12751	12737	2	6
13	12723	12709	12695	12681	12667	12652	12638	12624	12610	12596	12582	12568	3	8
14	12554	12540	12527	12513	12499	12485	12471	12457	12443	12429	12415	12401	4	11
15	12388	12374	12360	12346	12332	12318	12305	12291	12277	12263	12250	12236	s	13
16	12222	12208	12195	12181	12167	12154	12140	12126	12113	12099	12085	12072	1	3
17	12058	12044	12031	12017	12004	11990	11977	11963	11950	11936	11922	11909	2	5
18	11896	11882	11869	11855	11842	11828	11815	11801	11788	11775	11761	11748	3	8
19	11734	11721	11708	11694	11681	11668	11654	11641	11628	11614	11601	11588	4	10
20	0.11575	11561	11548	11535	11522	11509	11495	11482	11469	11456	11443	11429	s	13
21	11416	11403	11390	11377	11364	11351	11338	11325	11312	11299	11286	11272	1	3
22	11259	11246	11233	11220	11207	11194	11182	11169	11156	11143	11130	11117	2	5
23	11104	11091	11078	11065	11052	11040	11027	11014	11001	10988	10975	10963	3	8
24	10950	10937	10924	10911	10899	10886	10873	10861	10848	10835	10822	10810	4	10
25	10797	10784	10772	10759	10746	10734	10721	10709	10696	10683	10671	10658	s	12
26	10646	10633	10621	10608	10595	10583	10570	10558	10545	10533	10520	10508	1	2
27	10496	10483	10471	10458	10446	10433	10421	10409	10396	10384	10372	10359	2	5
28	10347	10335	10322	10310	10298	10285	10273	10261	10248	10236	10224	10212	3	7
29	10199	10187	10175	10163	10151	10138	10126	10114	10102	10090	10078	10066	4	10
30	0.10053	10041	10029	10017	10005	09993	09981	09969	09957	09945	09933	09921	s	12
31	09909	09897	09885	09873	09861	09849	09837	09825	09813	09801	09789	09777	1	2
32	09765	09753	09741	09730	09718	09706	09694	09682	09670	09658	09647	09635	2	5
33	09623	09611	09599	09588	09576	09564	09552	09541	09529	09517	09506	09494	3	7
34	09482	09471	09459	09447	09436	09424	09412	09401	09389	09377	09366	09354	4	10
35	09343	09331	09319	09308	09296	09285	09273	09262	09250	09239	09227	09216	s	11
36	09204	09193	09181	09170	09158	09147	09136	09124	09113	09101	09090	09079	1	2
37	09067	09056	09045	09033	09022	09011	08999	08988	08977	08965	08954	08943	2	4
38	08931	08920	08909	08898	08886	08875	08864	08853	08842	08830	08819	08808	3	7
39	08797	08786	08775	08763	08752	08741	08730	08719	08708	08697	08686	08675	4	9
40	0.08664	08653	08642	08630	08619	08608	08597	08586	08575	08564	08553	08542	s	11
41	08532	08521	08510	08499	08488	08477	08466	08455	08444	08433	08422	08412	1	2
42	08401	08390	08379	08368	08357	08347	08336	08325	08314	08303	08293	08282	2	4
43	08271	08260	08250	08239	08228	08217	08207	08196	08185	08175	08164	08153	3	7
44	08143	08132	08121	08111	08100	08089	08079	08068	08058	08047	08037	08026	4	9
45	08015	08005	07994	07984	07973	07963	07952	07942	07931	07921	07910	07900	s	10
46	07889	07879	07869	07858	07848	07837	07827	07816	07806	07796	07785	07775	1	2
47	07765	07754	07744	07734	07723	07713	07703	07692	07682	07672	07661	07651	2	4
48	07641	07631	07620	07610	07600	07590	07580	07569	07559	07549	07539	07529	3	6
49	07518	07508	07498	07488	07478	07468	07458	07448	07437	07427	07417	07407	4	8
50	0.07397	07387	07377	07367	07357	07347	07337	07327	07317	07307	07297	07287	s	10
51	07277	07267	07257	07247	07237	07227	07217	07207	07198	07188	07178	07168	1	2
52	07158	07148	07138	07128	07119	07109	07099	07089	07079	07070	07060	07050	2	4
53	07040	07030	07021	07011	07001	06991	06982	06972	06962	06953	06943	06933	3	6
54	06923	06914	06904	06894	06885	06875	06866	06856	06846	06837	06827	06818	4	8
55	06808	06798	06789	06779	06770	06760	06751	06741	06732	06722	06712	06703	s	10
56	06693	06684	06675	06665	06656	06646	06637	06627	06618	06608	06599	06590	1	2
57	06580	06571	06561	06552	06543	06533	06524	06515	06505	06496	06487	06477	2	4
58	06468	06459	06449	06440	06431	06422	06412	06403	06394	06385	06375	06366	3	6
59	06357	06348	06339	06329	06320	06311	06302	06293	06284	06274	06265	06256	4	8

TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

HALF ELAPSED TIME.

4 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	0.06247	06238	06229	06220	06211	06202	06192	06183	06174	06165	06156	06147	s	9
1	06138	06129	06120	06111	06102	06093	06084	06075	06066	06057	06048	06039	1	2
2	06030	06021	06013	06004	05995	05986	05977	05968	05959	05950	05941	05933	2	4
3	05924	05915	05906	05897	05888	05880	05871	05862	05853	05844	05836	05827	3	5
4	05818	05809	05801	05792	05783	05774	05766	05757	05748	05740	05731	05722	4	7
5	05714	05705	05696	05688	05679	05670	05662	05653	05645	05636	05627	05619	s	9
6	05610	05602	05593	05585	05576	05567	05559	05550	05542	05533	05525	05516	1	2
7	05508	05499	05491	05482	05474	05466	05457	05449	05440	05432	05423	05415	2	4
8	05407	05398	05390	05381	05373	05365	05356	05348	05340	05331	05323	05315	3	5
9	05306	05298	05290	05281	05273	05265	05257	05248	05240	05232	05224	05215	4	7
10	0.05207	05199	05191	05183	05174	05166	05158	05150	05142	05133	05125	05117	s	8
11	05109	05101	05093	05085	05077	05068	05060	05052	05044	05036	05028	05020	1	2
12	05012	05004	04996	04988	04980	04972	04964	04956	04948	04940	04932	04924	2	3
13	04916	04908	04900	04892	04884	04876	04868	04860	04852	04845	04837	04829	3	5
14	04821	04813	04805	04797	04790	04782	04774	04766	04758	04750	04743	04735	4	6
15	04727	04719	04711	04704	04696	04688	04680	04673	04665	04657	04649	04642	s	8
16	04634	04626	04619	04611	04603	04596	04588	04580	04573	04565	04557	04550	1	2
17	04542	04535	04527	04519	04512	04504	04497	04489	04481	04474	04466	04459	2	3
18	04451	04444	04436	04429	04421	04414	04406	04399	04391	04384	04376	04369	3	5
19	04361	04354	04346	04339	04332	04324	04317	04309	04302	04295	04287	04280	4	6
20	0.04272	04265	04258	04250	04243	04236	04228	04221	04214	04206	04199	04192	s	7
21	04185	04177	04170	04163	04156	04148	04141	04134	04127	04119	04112	04105	1	1
22	04098	04091	04083	04076	04069	04062	04055	04048	04040	04033	04026	04019	2	3
23	04012	04005	03998	03991	03984	03976	03969	03962	03955	03948	03941	03934	3	4
24	03927	03920	03913	03906	03899	03892	03885	03878	03871	03864	03857	03850	4	6
25	03843	03836	03829	03822	03815	03809	03802	03795	03788	03781	03774	03767	s	7
26	03760	03753	03747	03740	03733	03726	03719	03712	03706	03699	03692	03685	1	1
27	03678	03672	03665	03658	03651	03645	03638	03631	03624	03618	03611	03604	2	3
28	03597	03591	03584	03577	03571	03564	03557	03551	03544	03537	03531	03524	3	4
29	03517	03511	03504	03498	03491	03484	03478	03471	03465	03458	03452	03445	4	6
30	0.03439	03432	03425	03419	03412	03406	03399	03393	03386	03380	03373	03367	s	6
31	03361	03354	03348	03341	03335	03328	03322	03315	03309	03303	03296	03290	1	1
32	03283	03277	03271	03264	03258	03252	03245	03239	03233	03226	03220	03214	2	2
33	03207	03201	03195	03189	03182	03176	03170	03163	03157	03151	03145	03138	3	4
34	03132	03126	03120	03114	03107	03101	03095	03089	03083	03077	03070	03064	4	5
35	03058	03052	03046	03040	03034	03027	03021	03015	03009	03003	02997	02991	s	6
36	02985	02979	02973	02967	02961	02955	02949	02943	02937	02931	02925	02919	1	1
37	02913	02907	02901	02895	02889	02883	02877	02871	02865	02859	02853	02847	2	2
38	02841	02835	02829	02824	02818	02812	02806	02800	02794	02788	02783	02777	3	4
39	02771	02765	02759	02753	02748	02742	02736	02730	02725	02719	02713	02707	4	5
40	0.02701	02696	02690	02684	02679	02673	02667	02661	02656	02650	0264[illegible]	02639	s	5
41	02633	02627	02622	02616	02610	02605	02599	02593	02588	02582	02577	02571	1	1
42	02565	02560	02554	02549	02543	02538	02532	02526	02521	02515	02510	02504	2	2
43	02499	02493	02488	02482	02477	02471	02466	02460	02455	02449	02444	02438	3	3
44	02433	02428	02422	02417	02411	02406	02401	02395	02390	02384	02379	02374	4	4
45	02368	02363	02358	02352	02347	02342	02336	02331	02326	02320	02315	02310	s	5
46	02304	02299	02294	02289	02283	02278	02273	02268	02262	02257	02252	02247	1	1
47	02241	02236	02231	02226	02221	02215	02210	02205	02200	02195	02190	02185	2	2
48	02179	02174	02169	02164	02159	02154	02149	02144	02139	02134	02128	02123	3	3
49	02118	02113	02108	02103	02098	02093	02088	02083	02078	02073	02068	02063	4	4
50	0.02058	02053	02048	02043	02038	02033	02028	02023	02018	02014	02009	02004	s	5
51	01999	01994	01989	01984	01979	01974	01970	01965	01960	01955	01950	01945	1	1
52	01940	01936	01931	01926	01921	01916	01912	01907	01902	01897	01892	01888	2	2
53	01883	01878	01873	01869	01864	01859	01855	01850	01845	01840	01836	01831	3	3
54	01826	01822	01817	01812	01808	01803	01798	01794	01789	01785	01780	01775	4	4
55	01771	01766	01761	01757	01752	01748	01743	01739	01734	01730	01725	01720	s	4
56	01716	01711	01707	01702	01698	01693	01689	01684	01680	01675	01671	01666	1	1
57	01662	01658	01653	01649	01644	01640	01635	01631	01627	01622	01618	01613	2	2
58	01609	01605	01600	01596	01592	01587	01583	01578	01574	01570	01566	01561	3	2
59	01557	01553	01548	01344	01540	01535	01531	01527	01523	01518	01514	01510	4	3

TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

HALF ELAPSED TIME.

5 Hours.

M	0^s	5^s	10^s	15^s	20^s	25^s	30^s	35^s	40^s	45^s	50^s	55^s	Pro. pts.	
0	0.01506	01501	01497	01493	01489	01485	01480	01476	01472	01468	01464	01460	s	4
1	01455	01451	01447	01443	01439	01435	01431	01426	01422	01418	01414	01410	1	1
2	01406	01402	01398	01394	01390	01386	01382	01377	01373	01369	01365	01361	2	2
3	01357	01353	01349	01345	01341	01337	01333	01329	01325	01321	01318	01314	3	2
4	01310	01306	01302	01298	01294	01290	01286	01282	01278	01274	01271	01267	4	3
5	01263	01259	01255	01251	01247	01244	01240	01236	01232	01228	01224	01221	s	4
6	01217	01213	01209	01206	01202	01198	01194	01191	01187	01183	01179	01176	1	1
7	01172	01168	01164	01161	01157	01153	01150	01146	01142	01139	01135	01131	2	2
8	01128	01124	01120	01117	01113	01110	01106	01102	01099	01095	01092	01088	3	2
9	01084	01081	01077	01074	01070	01067	01063	01059	01056	01052	01049	01045	4	3
10	0.01042	01038	01035	01031	01028	01024	01021	01018	01014	01011	01007	01004	s	3
11	01000	00997	00993	00990	00987	00983	00980	00976	00973	00970	00966	00963	1	1
12	00960	00956	00953	00950	00946	00943	00940	00936	00933	00930	00926	00923	2	1
13	00920	00916	00913	00910	00907	00903	00900	00897	00894	00890	00887	00884	3	2
14	00881	00878	00874	00871	00868	00865	00862	00858	00855	00852	00849	00846	4	2
15	00843	00840	00836	00833	00830	00827	00824	00821	00818	00815	00812	00808	s	3
16	00805	00802	00799	00796	00793	00790	00787	00784	00781	00778	00775	00772	1	1
17	00769	00766	00763	00760	00757	00754	00751	00748	00745	00742	00739	00736	2	1
18	00733	00731	00728	00725	00722	00719	00716	00713	00710	00707	00704	00702	3	2
19	00699	00696	00693	00690	00687	00685	00682	00679	00676	00673	00670	00668	4	2
20	0.00665	00662	00659	00657	00654	00651	00648	00646	00643	00640	00637	00635	s	3
21	00632	00629	00627	00624	00621	00618	00616	00613	00610	00608	00605	00602	1	1
22	00600	00597	00595	00592	00589	00587	00584	00581	00579	00576	00574	00571	2	1
23	00568	00566	00563	00561	00558	00556	00553	00551	00548	00546	00543	00541	3	2
24	00538	00536	00533	00531	00528	00526	00523	00521	00518	00516	00513	00511	4	2
25	00508	00506	00504	00501	00499	00496	00494	00492	00489	00487	00484	00482	s	2
26	00480	00477	00475	00473	00470	00468	00466	00463	00461	00459	00456	00454	1	0
27	00452	00450	00447	00445	00443	00440	00438	00436	00434	00431	00429	00427	2	1
28	00425	00423	00420	00418	00416	00414	00412	00409	00407	00405	00403	00401	3	1
29	00399	00396	00394	00392	00390	00388	00386	00384	00382	00379	00377	00375	4	2
30	0.00373	00371	00369	00367	00365	00363	00361	00359	00357	00355	00353	00351	s	2
31	00349	00347	00345	00343	00341	00339	00337	00335	00333	00331	00329	00327	1	0
32	00325	00323	00321	00319	00317	00315	00313	00312	00310	00308	00306	00304	2	1
33	00302	00300	00298	00297	00295	00293	00291	00289	00287	00286	00284	00282	3	1
34	00280	00278	00277	00275	00273	00271	00269	00267	00266	00264	00262	00261	4	2
35	00259	00257	00256	00254	00252	00250	00249	00247	00245	00244	00242	00240	s	2
36	00239	00237	00235	00234	00232	00230	00229	00227	00226	00224	00222	00221	1	0
37	00219	00218	00216	00214	00213	00211	00210	00208	00207	00205	00204	00202	2	1
38	00200	00199	00197	00196	00194	00193	00191	00190	00188	00187	00186	00184	3	1
39	00183	00181	00180	00178	00177	00175	00174	00173	00171	00170	00168	00167	4	2
40	0.00166	00164	00163	00162	00160	00159	00157	00156	00155	00153	00152	00151	s	1
41	00149	00148	00147	00146	00144	00143	00142	00140	00139	00138	00137	00135	1	0
42	00134	00133	00132	00130	00129	00128	00127	00126	00124	00123	00122	00121	2	0
43	00120	00118	00117	00116	00115	00114	00113	00112	00110	00109	00108	00107	3	1
44	00106	00105	00104	00103	00102	00101	00099	00098	00097	00096	00095	00094	4	1
45	00093	00092	00091	00090	00089	00088	00087	00086	00085	00084	00083	00082	s	1
46	00081	00080	00079	00078	00077	00076	00075	00075	00074	00073	00072	00071	1	0
47	00070	00069	00068	00067	00066	00066	00065	00064	00063	00062	00061	00060	2	0
48	00060	00059	00058	00057	00056	00056	00055	00054	00053	00052	00052	00051	3	1
49	00050	00049	00049	00048	00047	00046	00046	00045	00044	00044	00043	00042	4	1
50	0.00041	00041	00040	00039	00039	00038	00037	00037	00036	00035	00035	00034	s	1
51	00034	00033	00032	00032	00031	00031	00030	00029	00029	00028	00028	00027	1	0
52	00027	00026	00025	00025	00024	00024	00023	00023	00022	00022	00021	00021	2	0
53	00020	00020	00019	00019	00018	00018	00017	00017	00016	00016	00016	00015	3	0
54	00015	00015	00014	00014	00013	00013	00013	00012	00012	00011	00011	00011	4	1
55	00010	00010	00010	00009	00009	00009	00008	00008	00008	00008	00007	00007	s	1
56	00007	00006	00006	00006	00006	00005	00005	00005	00005	00004	00004	00004	1	0
57	00004	00004	00003	00003	00003	00003	00003	00002	00002	00002	00002	00002	2	0
58	00002	00002	00001	00001	00001	00001	00001	00001	00001	00001	00001	00001	3	0
59	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	4	1

TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

MIDDLE TIME.

0 Hour.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.
0	2.00000	86167	16270	33879	46373	56064	63982	70676	76476	81591	86167	90306	
1	94085	97561	00779	03776	06578	09211	11694	14042	16269	18388	20408	22339	
2	3.24187	25960	27663	29302	30882	32406	33878	35302	36681	38017	39313	40572	
3	41796	42986	44144	45272	46371	47443	48490	49512	50510	51486	52440	53374	
4	54289	55184	56061	56921	57764	58592	59403	60200	60982	61751	62506	63249	
5	63978	64696	65402	66097	66781	67454	68117	68770	69413	70047	70672	71288	
6	71895	72494	73085	73667	74242	74810	75370	75923	76469	77009	77542	78068	
7	78568	79102	79609	80111	80607	81098	81583	82063	82537	83007	83471	83930	
8	84385	84835	85280	85721	86157	86589	87017	87440	87860	88275	88686	89094	
9	89498	89898	90294	90687	91076	91462	91845	92224	92600	92972	93341	93708	
10	3.94071	94431	94788	95143	95494	95843	96188	96532	96872	97210	97545	97877	s 300
11	98207	98535	98860	99183	99503	99821	00136	00450	00761	01070	01376	01681	1 60
12	4.01983	02283	02581	02878	03172	03464	03754	04043	04329	04613	04896	05177	2 120
13	05456	05733	06008	06282	06554	06824	07093	07360	07625	07889	08151	08412	3 180
14	08671	08928	09184	09438	09691	09943	10193	10441	10688	10934	11178	11421	4 240
15	11663	11903	12142	12380	12616	12851	13085	13317	13549	13779	14007	14235	s 210
16	14461	14687	14911	15134	15355	15576	15796	16014	16231	16448	16663	16877	1 42
17	17090	17302	17513	17723	17932	18139	18346	18552	18757	18962	19164	19366	2 84
18	19567	19768	19967	20165	20363	20559	20755	20950	21143	21336	21529	21720	3 126
19	21910	22100	22289	22477	22664	22850	23036	23221	23404	23588	23770	23952	4 168
20	4.24133	24313	24492	24671	24849	25026	25202	25378	25553	25727	25901	26074	s 162
21	26246	26417	26588	26758	26928	27097	27265	27432	27599	27765	27931	28096	1 32
22	28260	28424	28587	28750	28911	29073	29233	29393	29553	29712	29870	30028	2 65
23	30185	30341	30497	30653	30807	30962	31115	31269	31421	31573	31725	31876	3 97
24	32026	32176	32326	32475	32623	32771	32919	33066	33212	33358	33503	33648	4 130
25	33793	33937	34080	34223	34365	34508	34649	34790	34931	35071	35211	35350	s 132
26	35489	35627	35765	35903	36040	36176	36313	36448	36584	36719	36853	36987	1 26
27	37121	37254	37387	37519	37651	37783	37914	38045	38175	38305	38434	38564	2 53
28	38692	38821	38949	39077	39204	39331	39457	39583	39709	39835	39960	40084	3 79
29	40209	40333	40456	40579	40702	40825	40947	41069	41190	41311	41432	41553	4 106
30	4.41673	41793	41912	42031	42150	42268	42386	42504	42622	42739	42856	42972	s 111
31	43088	43204	43320	43435	43550	43665	43779	43893	44007	44120	44233	44346	1 22
32	44459	44571	44683	44794	44906	45017	45127	45238	45348	45458	45568	45677	2 44
33	45786	45895	46003	46111	46219	46327	46434	46542	46648	46755	46861	46967	3 67
34	47073	47179	47284	47389	47494	47598	47702	47807	47910	48014	48117	48220	4 89
35	48323	48425	48527	48629	48731	48833	48934	49035	49136	49236	49336	49436	s 96
36	49536	49636	49735	49834	49933	50032	50130	50229	50326	50424	50522	50619	1 19
37	50716	50813	50910	51006	51102	51198	51294	51389	51485	51580	51675	51769	2 38
38	51864	51958	52052	52146	52240	52333	52426	52519	52612	52705	52797	52889	3 57
39	52981	53073	53165	53256	53347	53438	53529	53620	53710	53801	53891	53980	4 77
40	4.54070	54160	54249	54338	54427	54515	54604	54692	54780	54868	54956	55044	s 85
41	55131	55219	55306	55392	55479	55566	55652	55738	55824	55910	55996	56081	1 17
42	56166	56251	56336	56421	56506	56590	56674	56759	56842	56926	57010	57093	2 34
43	57176	57260	57343	57425	57508	57590	57673	57755	57837	57918	58000	58082	3 51
44	58163	58244	58325	58406	58487	58567	58648	58728	58808	58888	58967	59047	4 68
45	59127	59206	59285	59364	59443	59522	59600	59679	59757	59835	59913	59991	s 75
46	60069	60146	60223	60301	60378	60455	60532	60608	60685	60761	60838	60914	1 15
47	60990	61066	61141	61217	61292	61368	61443	61518	61593	61667	61742	61817	2 30
48	61891	61965	62039	62113	62187	62261	62334	62408	62481	62554	62627	62700	3 45
49	62773	62846	62918	62991	63063	63135	63207	63279	63351	63422	63494	63565	4 60
50	4.63637	63708	63779	63850	63921	63991	64062	64132	64203	64273	64343	64413	s 68
51	64483	64553	64622	64692	64761	64830	64899	64968	65037	65106	65175	65243	1 14
52	65312	65380	65448	65517	65584	65652	65720	65788	65855	65923	65990	66057	2 27
53	66125	66192	66258	66325	66392	66458	66525	66591	66658	66724	66790	66856	3 41
54	66922	66987	67053	67118	67184	67249	67314	67379	67444	67509	67574	67639	4 54
55	67703	67768	67832	67897	67961	68025	68089	68153	68216	68280	68344	68407	s 62
56	68471	68534	68597	68660	68723	68786	68849	68912	68974	69037	69099	69161	1 12
57	69224	69286	69348	69410	69472	69533	69595	69657	69718	69779	69841	69902	2 25
58	69963	70024	70085	70146	70206	70267	70328	70388	70449	70509	70569	70629	3 37
59	70689	70749	70809	70869	70928	70988	71047	71107	71166	71225	71285	71344	4 50

TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

MIDDLE TIME.

1 Hour.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	4.71403	71462	71520	71579	71638	71696	71755	71813	71871	71930	71988	72046	s	56
1	72104	72162	72219	72277	72335	72392	72450	72507	72564	72622	72679	72736	1	11
2	72793	72850	72907	72963	73020	73077	73133	73190	73246	73302	73358	73414	2	22
3	73470	73526	73582	73638	73694	73749	73805	73861	73916	73971	74027	74082	3	34
4	74137	74192	74247	74302	74356	74411	74466	74521	74575	74629	74684	74738	4	45
5	74792	74846	74900	74955	75008	75062	75116	75170	75223	75277	75330	75384	s	52
6	75437	75491	75544	75597	75650	75703	75756	75809	75861	75914	75967	76019	1	10
7	76072	76124	76177	76229	76281	76333	76385	76437	76489	76541	76593	76645	2	21
8	76697	76748	76800	76851	76903	76954	77005	77057	77108	77159	77210	77261	3	31
9	77312	77362	77413	77464	77514	77565	77616	77666	77716	77767	77817	77867	4	42
10	4.77917	77967	78017	78067	78117	78167	78217	78266	78316	78365	78415	78464	s	48
11	78514	78563	78612	78661	78710	78760	78809	78858	78906	78955	79004	79053	1	10
12	79101	79150	79198	79247	79295	79344	79392	79440	79488	79536	79584	79632	2	19
13	79680	79728	79776	79824	79871	79919	79966	80014	80061	80109	80156	80203	3	29
14	80251	80298	80345	80392	80439	80486	80533	80580	80626	80673	80720	80766	4	38
15	80813	80859	80906	80952	80999	81045	81091	81137	81183	81229	81275	81321	s	45
16	81367	81413	81459	81505	81550	81596	81641	81687	81732	81778	81823	81868	1	9
17	81914	81959	82004	82049	82094	82139	82184	82229	82274	82319	82363	82408	2	18
18	82453	82497	82542	82586	82630	82675	82719	82763	82808	82852	82896	82940	3	27
19	82984	83028	83072	83116	83159	83203	83247	83291	83334	83378	83421	83465	4	36
20	4.83508	83552	83595	83638	83681	83725	83768	83811	83854	83897	83940	83983	s	42
21	84025	84068	84111	84154	84196	84239	84281	84324	84366	84409	84451	84493	1	8
22	84536	84578	84620	84662	84704	84746	84788	84830	84872	84914	84956	84997	2	17
23	85039	85081	85122	85164	85205	85247	85288	85330	85371	85412	85454	85495	3	25
24	85536	85577	85618	85659	85700	85741	85782	85823	85864	85904	85945	85986	4	34
25	86026	86067	86108	86148	86188	86229	86269	86310	86350	86390	86430	86470	s	40
26	86511	86551	86591	86631	86671	86710	86750	86790	86830	86870	86909	86949	1	8
27	86989	87028	87068	87107	87147	87186	87225	87265	87304	87343	87382	87421	2	16
28	87461	87500	87539	87578	87617	87656	87694	87733	87772	87811	87849	87888	3	24
29	87927	87965	88004	88042	88081	88119	88158	88196	88234	88272	88311	88349	4	32
30	4.88387	88425	88463	88501	88539	88577	88615	88653	88691	88729	88766	88804	s	37
31	88842	88879	88917	88954	88992	89030	89067	89104	89142	89179	89216	89254	1	7
32	89291	89328	89365	89402	89439	89476	89513	89550	89587	89624	89661	89698	2	15
33	89735	89771	89808	89845	89881	89918	89954	89991	90027	90064	90100	90137	3	22
34	90173	90209	90246	90282	90318	90354	90390	90426	90462	90498	90534	90570	4	30
35	90606	90642	90678	90714	90749	90785	90821	90857	90892	90928	90963	90999	s	35
36	91034	91070	91105	91141	91176	91211	91247	91282	91317	91352	91387	91422	1	7
37	91457	91493	91527	91563	91597	91632	91667	91702	91737	91772	91806	91841	2	14
38	91876	91910	91945	91980	92014	92049	92083	92117	92152	92186	92221	92255	3	21
39	92289	92323	92358	92392	92426	92460	92494	92528	92562	92596	92630	92664	4	28
40	4.92698	92732	92765	92799	92833	92867	92900	92934	92968	93001	93035	93068	s	33
41	93102	93135	93169	93202	93236	93269	93302	93336	93369	93402	93435	93468	1	7
42	93501	93535	93568	93601	93634	93667	93700	93732	93765	93798	93831	93864	2	13
43	93897	93929	93962	93995	94027	94060	94092	94125	94157	94190	94222	94255	3	20
44	94287	94320	94352	94384	94416	94449	94481	94513	94545	94577	94609	94642	4	26
45	94674	94706	94738	94770	94801	94833	94865	94897	94929	94961	94992	95024	s	31
46	95056	95087	95119	95151	95182	95214	95245	95277	95308	95340	95371	95402	1	6
47	95434	95465	95496	95528	95559	95590	95621	95652	95683	95715	95746	95777	2	12
48	95808	95839	95870	95901	95931	95962	95993	96024	96055	96086	96116	96147	3	19
49	96178	96208	96239	96269	96300	96331	96361	96392	96422	96452	96483	96513	4	25
50	4.96544	96574	96604	96634	96665	96695	96725	96755	96785	96816	96846	96876	s	30
51	96906	96936	96966	96996	97025	97055	97085	97115	97145	97175	97204	97234	1	6
52	97264	97294	97323	97353	97383	97412	97442	97471	97501	97530	97560	97589	2	12
53	97618	97648	97677	97707	97736	97765	97794	97824	97853	97882	97911	97940	3	18
54	97969	97998	98027	98056	98085	98114	98143	98172	98201	98230	98259	98288	4	24
55	98316	98345	98374	98403	98431	98460	98489	98517	98546	98575	98603	98632	s	29
56	98660	98689	98717	98746	98774	98802	98831	98859	98887	98916	98944	98972	1	6
57	99000	99028	99057	99085	99113	99141	99169	99197	99225	99253	99281	99309	2	12
58	99337	99365	99393	99421	99448	99476	99504	99532	99559	99587	99615	99643	3	17
59	99670	99698	99725	99753	99780	99808	99835	99863	99890	99918	99945	99973	4	23

TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

MIDDLE TIME.

2 Hours.

M	0^{s}	5^{s}	10^{s}	15^{s}	20^{s}	25^{s}	30^{s}	35^{s}	40^{s}	45^{s}	50^{s}	55^{s}	Pro. pts.	
0	5.00000	00027	00055	00082	00109	00137	00164	00191	00218	00245	00272	00300	s	26
1	00327	00354	00381	00408	00435	00462	00489	00516	00542	00569	00596	00623	1	5
2	00650	00677	00703	00730	00757	00784	00810	00837	00864	00890	00917	00943	2	10
3	00970	00997	01023	01050	01076	01103	01129	01155	01182	01208	01234	01261	3	16
4	01287	01313	01339	01366	01392	01418	01444	01470	01496	01523	01549	01575	4	21
5	01601	01627	01653	01679	01705	01731	01757	01782	01808	01834	01860	01886	s	25
6	01912	01937	01963	01989	02014	02040	02066	02091	02117	02143	02168	02194	1	5
7	02219	02245	02270	02296	02321	02347	02372	02397	02423	02448	02473	02499	2	10
8	02524	02549	02574	02600	02625	02650	02675	02700	02725	02751	02776	02801	3	15
9	02826	02851	02876	02901	02926	02951	02976	03001	03025	03050	03075	03100	4	20
10	5.03125	03149	03174	03199	03224	03248	03273	03298	03322	03347	03372	03396	s	24
11	03421	03445	03470	03494	03519	03543	03568	03592	03616	03641	03665	03690	1	5
12	03714	03738	03762	03787	03811	03835	03859	03884	03908	03932	03956	03980	2	10
13	04004	04028	04052	04077	04100	04125	04148	04172	04196	04220	04244	04268	3	14
14	04292	04316	04340	04363	04387	04411	04435	04459	04482	04506	04530	04553	4	19
15	04577	04601	04624	04648	04671	04695	04718	04742	04765	04789	04812	04836	s	23
16	04859	04883	04906	04929	04953	04976	04999	05023	05046	05069	05092	05116	1	5
17	05139	05162	05185	05208	05231	05255	05278	05301	05324	05347	05370	05393	2	9
18	05416	05439	05462	05485	05508	05531	05553	05576	05599	05622	05645	05668	3	14
19	05690	05713	05736	05758	05781	05804	05827	05849	05872	05894	05917	05940	4	18
20	5.05962	05985	06007	06030	06052	06075	06097	06120	06142	06164	06187	06209	s	22
21	06232	06254	06276	06299	06321	06343	06365	06388	06410	06432	06454	06476	1	4
22	06498	06521	06543	06565	06587	06609	06631	06653	06675	06697	06719	06741	2	9
23	06763	06785	06807	06829	06850	06872	06894	06916	06938	06960	06981	07003	3	13
24	07025	07047	07068	07090	07112	07133	07155	07176	07198	07220	07241	07263	4	18
25	07284	07306	07328	07349	07371	07392	07413	07435	07456	07478	07499	07520	s	21
26	07542	07563	07584	07606	07627	07648	07670	07691	07712	07733	07754	07776	1	4
27	07797	07818	07839	07860	07881	07902	07923	07944	07965	07986	08007	08028	2	8
28	08049	08070	08091	08112	08133	08154	08175	08196	08216	08237	08258	08279	3	13
29	08300	08320	08341	08362	08383	08403	08424	08445	08465	08486	08507	08527	4	17
30	5.08548	08568	08589	08609	08630	08650	08671	08691	08712	08732	08753	08773	s	20
31	08794	08814	08834	08855	08875	08895	08916	08936	08956	08977	08997	09017	1	4
32	09037	09057	09078	09098	09118	09138	09158	09178	09198	09219	09239	09259	2	8
33	09279	09299	09319	09339	09359	09379	09399	09419	09438	09458	09478	09498	3	12
34	09518	09538	09558	09577	09597	09617	09637	09657	09676	09696	09716	09735	4	16
35	09755	09775	09794	09814	09834	09853	09873	09893	09912	09932	09951	09971	s	19
36	09990	10010	10029	10049	10068	10088	10107	10126	10146	10165	10184	10204	1	4
37	10223	10243	10262	10281	10300	10320	10339	10358	10377	10397	10416	10435	2	8
38	10454	10473	10492	10512	10531	10550	10569	10588	10607	10626	10645	10664	3	11
39	10683	10702	10721	10740	10759	10778	10797	10816	10834	10853	10872	10891	4	15
40	5.10910	10929	10947	10966	10985	11004	11022	11041	11060	11079	11097	11116	s	18
41	11135	11153	11172	11190	11209	11228	11246	11265	11283	11302	11320	11339	1	4
42	11357	11376	11394	11413	11431	11450	11468	11487	11505	11523	11542	11560	2	7
43	11578	11597	11615	11633	11652	11670	11688	11706	11725	11743	11761	11779	3	11
44	11797	11815	11834	11852	11870	11888	11906	11924	11942	11960	11978	11996	4	14
45	12014	12032	12050	12068	12086	12104	12122	12140	12158	12176	12194	12112	s	18
46	12229	12247	12265	12283	12301	12319	12336	12354	12372	12390	12407	12425	1	4
47	12443	12460	12478	12496	12513	12531	12549	12566	12584	12601	12619	12637	2	7
48	12654	12672	12689	12707	12724	12742	12759	12777	12794	12811	12829	12846	3	11
49	12864	12881	12898	12916	12933	12950	12968	12985	13002	13020	13037	13054	4	14
50	5.13071	13089	13106	13123	13140	13157	13175	13192	13209	13226	13243	13260	s	17
51	13277	13294	13311	13228	13345	13363	13380	13397	13413	13431	13447	13464	1	3
52	13481	13498	13515	13532	13549	13566	13583	13600	13616	13633	13650	13667	2	7
53	13684	13700	13717	13734	13751	13767	13784	13801	13818	13834	13851	13868	3	10
54	13884	13901	13917	13934	13951	13967	13984	14000	14017	14034	14050	14067	4	14
55	14083	14100	14116	14133	14149	14165	14182	14198	14215	14231	14247	14264	s	16
56	14280	14297	14313	14329	14345	14362	14378	14394	14411	14427	14413	14459	1	3
57	14476	14492	14508	14524	14540	14556	14573	14589	14605	14621	14637	14653	2	6
58	14669	14685	14701	14717	14733	14749	14765	14781	14797	14813	14829	14845	3	10
59	14861	14877	14893	14909	14925	14941	14957	14972	14988	15004	15020	15036	4	13

TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

MIDDLE TIME.

3 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	5.15051	15067	15083	15099	15115	15130	15146	15162	15177	15193	15209	15225	s	16
1	15240	15256	15271	15287	15303	15318	15334	15350	15365	15381	15396	15412	1	3
2	15427	15443	15458	15474	15489	15505	15520	15536	15551	15566	15582	15597	2	6
3	15613	15628	15643	15659	15674	15689	15705	15720	15735	15751	15766	15781	3	10
4	15796	15812	15827	15842	15857	15873	15888	15903	15918	15933	15948	15964	4	13
5	15979	15994	16009	16024	16039	16054	16069	16084	16099	16114	16129	16144	s	15
6	16159	16174	16189	16204	16219	16234	16249	16264	16279	16294	16309	16323	1	3
7	16338	16353	16368	16383	16398	16412	16427	16442	16457	16472	16486	16501	2	6
8	16516	16531	16545	16560	16575	16589	16604	16619	16633	16648	16662	16677	3	9
9	16692	16706	16721	16735	16750	16765	16779	16794	16808	16823	16837	16852	4	12
10	5.16866	16881	16895	16909	16924	16938	16953	16967	16982	16996	17010	17025	s	14
11	17039	17053	17068	17082	17096	17111	17125	17139	17153	17168	17182	17196	1	3
12	17210	17225	17239	17253	17267	17281	17295	17310	17324	17338	17352	17366	2	6
13	17380	17394	17408	17423	17437	17451	17465	17479	17493	17507	17521	17535	3	8
14	17549	17563	17577	17591	17604	17618	17632	17646	17660	17674	17688	17702	4	11
15	17716	17729	17743	17757	17771	17785	17798	17812	17826	17840	17854	17867	s	13
16	17881	17895	17908	17922	17936	17950	17963	17977	17990	18004	18018	18031	1	3
17	18045	18059	18072	18086	18099	18113	18126	18140	18154	18167	18181	18194	2	5
18	18208	18221	18235	18248	18261	18275	18288	18302	18315	18329	18342	18355	3	8
19	18369	18382	18395	18409	18422	18435	18449	18462	18475	18489	18502	18515	4	10
20	5.18528	18542	18555	18568	18581	18595	18608	18621	18634	18647	18660	18674	s	13
21	18687	18700	18713	18726	18739	18752	18765	18778	18791	18805	18818	18831	1	3
22	18844	18857	18870	18883	18896	18909	18922	18935	18947	18960	18973	18986	2	5
23	18999	19012	19025	19038	19051	19064	19076	19089	19102	19115	19128	19141	3	8
24	19153	19166	19179	19192	19204	19217	19230	19243	19255	19268	19281	19293	4	10
25	19306	19319	19331	19344	19357	19369	19382	19395	19407	19420	19432	19445	s	12
26	19457	19470	19483	19495	19508	19520	19533	19545	19558	19570	19583	19595	1	2
27	19607	19620	19632	19645	19657	19670	19682	19694	19707	19719	19732	19744	2	5
28	19756	19769	19781	19793	19805	19818	19830	19842	19855	19867	19879	19891	3	7
29	19904	19916	19928	19940	19952	19965	19977	19989	20001	20013	20025	20038	4	10
30	5.20050	20062	20074	20086	20098	20110	20122	20134	20146	20158	20170	20182	s	12
31	20194	20206	20218	20230	20242	20254	20266	20278	20290	20302	20314	20326	1	2
32	20338	20350	20362	20374	20385	20397	20409	20421	20433	20445	20456	20468	2	5
33	20480	20492	20504	20515	20527	20539	20551	20562	20574	20586	20597	20609	3	7
34	20621	20633	20644	20656	20668	20679	20691	20702	20714	20726	20737	20749	4	10
35	20760	20772	20784	20795	20807	20818	20830	20841	20853	20864	20876	20887	s	11
36	20899	20910	20922	20933	20945	20956	20967	20979	20990	21002	21013	21024	1	2
37	21036	21047	21059	21070	21081	21093	21104	21115	21126	21138	21149	21160	2	4
38	21172	21183	21194	21205	21217	21228	21239	21250	21261	21273	21284	21295	3	7
39	21306	21317	21328	21340	21351	21362	21373	21384	21395	21406	21417	21428	4	9
40	5.21439	21451	21462	21473	21484	21495	21506	21517	21528	21539	21550	21561	s	11
41	21572	21583	21593	21604	21615	21626	21637	21648	21659	21670	21681	21692	1	2
42	21702	21713	21724	21735	21746	21757	21767	21778	21789	21800	21810	21821	2	4
43	21832	21843	21853	21864	21875	21886	21896	21907	21918	21928	21939	21950	3	7
44	21960	21971	21982	21992	22003	22014	22024	22034	22045	22056	22067	22077	4	9
45	22088	22098	22109	22119	22130	22140	22151	22161	22172	22182	22193	22203	s	10
46	22214	22224	22235	22245	22255	22266	22276	22287	22297	22307	22318	22328	1	2
47	22338	22349	22359	22370	22380	22390	22400	22411	22421	22431	22442	22452	2	4
48	22462	22472	22483	22493	22503	22513	22524	22534	22544	22554	22564	22574	3	6
49	22585	22595	22605	22615	22625	22635	22645	22656	22666	22676	22686	22696	4	8
50	5.22706	22716	22726	22736	22746	22756	22766	22776	22786	22796	22806	22816	s	10
51	22826	22836	22846	22856	22866	22876	22886	22896	22906	22915	22925	22935	1	2
52	22945	22955	22965	22975	22984	22994	23004	23014	23024	23034	23043	23053	2	4
53	23063	23073	23082	23092	23102	23112	23121	23131	23141	23151	23160	23170	3	6
54	23180	23189	23199	23209	23218	23228	23237	23247	23257	23266	23276	23286	4	8
55	23295	23305	23314	23324	23333	23343	23352	23362	23372	23381	23391	23400	s	10
56	23410	23419	23429	23438	23447	23457	23466	23476	23485	23495	23504	23514	1	2
57	23523	23532	23542	23551	23560	23570	23579	23588	23598	23607	23616	23626	2	4
58	23635	23644	23654	23663	23672	23681	23691	23700	23709	23718	23728	23737	3	6
59	23746	23755	23765	23774	23783	23792	23801	23810	23820	23829	23838	23847	4	8

TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

MIDDLE TIME.

4 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.
0	5.23856	23865	23874	23883	23892	23902	23911	23920	23929	23938	23947	23956	s 9
1	23965	23974	23983	23992	24001	24010	24019	24028	24037	24046	24055	24064	1 2
2	24073	24082	24091	24099	24108	24117	24126	24135	24144	24153	24162	24171	2 4
3	24179	24188	24197	24206	24215	24224	24232	24241	24250	24259	24267	24276	3 5
4	24285	24294	24302	24311	24320	24329	24337	24346	24355	24363	24372	24381	4 7
5	24389	24398	24407	24415	24424	24433	24441	24450	24458	24467	24476	24484	s 9
6	24493	24501	24510	24519	24527	24536	24544	24553	24561	24570	24578	24587	1 2
7	24595	24604	24612	24621	24629	24638	24646	24654	24663	24671	24680	24688	2 4
8	24696	24705	24713	24722	24730	24738	24747	24755	24763	24772	24780	24788	3 5
9	24797	24805	24813	24822	24830	24838	24846	24855	24863	24871	24879	24888	4 7
10	5.24896	24904	24912	24921	24929	24937	24945	24953	24961	24970	24978	24986	s 8
11	24994	25002	25010	25018	25026	25035	25043	25051	25059	25067	25075	25083	1 2
12	25091	25099	25107	25115	25123	25131	25139	25147	25155	25163	25171	25179	2 3
13	25187	25195	25203	25211	25219	25227	25235	25243	25251	25259	25266	25274	3 5
14	25282	25290	25298	25306	25314	25321	25329	25337	25345	25353	25360	25368	4 6
15	25376	25384	25392	25399	25407	25415	25423	25430	25438	25445	25454	25460	s 8
16	25469	25477	25484	25492	25500	25507	25515	25523	25530	25538	25546	25553	1 2
17	25561	25569	25576	25584	25591	25599	25607	25614	25622	25629	25637	25644	2 3
18	25652	25659	25667	25674	25682	25689	25697	25704	25712	25719	25727	25734	3 5
19	25742	25749	25757	25764	25771	25779	25786	25794	25801	25808	25816	25823	4 6
20	5.25831	25838	25845	25853	25860	25867	25875	25882	25889	25897	25904	25911	s 7
21	25918	25926	25933	25940	25947	25955	25962	25969	25976	25984	25991	25998	1 1
22	26005	26013	26020	26027	26034	26041	26048	26056	26063	26070	26077	26084	2 3
23	26091	26098	26105	26113	26120	26127	26134	26141	26148	26155	26162	26169	3 4
24	26176	26183	26190	26197	26204	26211	26218	26225	26232	26239	26246	26253	4 6
25	26260	26267	26274	26281	26288	26295	26301	26308	26315	26322	26329	26336	s 7
26	26343	26350	26356	26363	26370	26377	26384	26391	26397	26404	26411	26418	1 1
27	26425	26432	26438	26445	26452	26459	26465	26472	26479	26486	26492	26499	2 3
28	26506	26512	26519	26526	26532	26539	26546	26552	26559	26566	26572	26579	3 4
29	26586	26592	26599	26605	26612	26619	26625	26632	26638	26645	26651	26658	4 6
30	5.26665	26671	26678	26684	26691	26697	26704	26710	26717	26723	26730	26736	s 6
31	26743	26749	26755	26762	26768	26775	26781	26788	26794	26800	26807	26813	1 1
32	26820	26826	26832	26839	26845	26851	26858	26864	26870	26877	26883	26889	2 2
33	26896	26902	26908	26915	26921	26927	26933	26940	26946	26952	26958	26965	3 4
34	26971	26977	26983	26989	26996	27002	27008	27014	27020	27027	27033	27039	4 5
35	27045	27051	27057	27063	27069	27076	27082	27088	27094	27100	27106	27112	s 6
36	27118	27124	27130	27136	27142	27148	27154	27160	27166	27172	27178	27184	1 1
37	27190	27196	27202	27208	27214	27220	27226	27232	27238	27244	27250	27256	2 2
38	27262	27268	27274	27279	27285	27291	27297	27303	27309	27315	27320	27336	3 4
39	27332	27338	27344	27350	27355	27361	27367	27373	27379	27384	27390	27396	4 5
40	5.27402	27407	27413	27419	27425	27430	27436	27442	27447	27453	27459	27464	s 5
41	27470	27476	27481	27487	27493	27498	27504	27510	27515	27521	27526	27532	1 1
42	27538	27543	27549	27554	27560	27566	27571	27577	27582	27588	27593	27599	2 2
43	27604	27610	27615	27621	27626	27632	27637	27643	27648	27654	27659	27665	3 3
44	27670	27675	27681	27686	27692	27697	27703	27708	27713	27719	27724	27729	4 4
45	27735	27740	27746	27751	27756	27762	27767	27772	27777	27783	27788	27793	s 5
46	27799	27804	27809	27815	27820	27825	27830	27836	27841	27846	27851	27856	1 1
47	27862	27867	27872	27877	27882	27888	27893	27898	27903	27908	27913	27919	2 2
48	27924	27929	27934	27939	27944	27949	27954	27959	27964	27970	27975	27980	3 3
49	27985	27990	27995	28000	28005	28010	28015	28020	28025	28030	28035	28040	4 4
50	5.28045	28050	28055	28060	28065	28070	28075	28080	28085	28090	28094	28099	s 5
51	28104	28109	28114	28119	28124	28129	28134	28138	28143	28148	28153	28158	1 1
52	28163	28168	28172	28177	28182	28187	28191	28196	28201	28206	28211	28215	2 2
53	28220	28225	28230	28234	28239	28244	28249	28253	28258	28263	28267	28272	3 3
54	28277	28281	28286	28291	28295	28300	28305	28309	28314	28319	28323	28328	4 4
55	28332	28337	28342	28346	28351	28355	28360	28364	28369	28374	28378	28383	s 4
56	28387	28392	28396	28401	28405	28410	28414	28419	28423	28428	28432	28437	1 1
57	28441	28446	28450	28454	28459	28463	28468	28472	28476	28481	28485	28490	2 2
58	28494	28498	28503	28507	28512	28516	28520	28525	28529	28533	28538	28542	3 2
59	28546	28551	28555	28559	28563	28568	28572	28576	28580	28585	28589	28593	4 3

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

MIDDLE TIME.

5 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	5.28597	28602	28606	28610	28614	28619	28623	28627	28631	28635	28639	28644	s	4
1	28648	28652	28656	28660	28664	28668	28673	28677	28681	28685	28689	28693	1	1
2	28697	28701	28705	28709	28713	28718	28722	28726	28730	28734	28738	28742	2	2
3	28746	28750	28754	28758	28762	28766	28770	28774	28778	28782	28786	28790	3	2
4	28793	28797	28801	28805	28809	28813	28817	28821	28825	28829	28832	28836	4	3
5	28840	28844	28848	28852	28856	28860	28863	28867	28871	28875	28879	28882	s	4
6	28886	28890	28894	28898	28901	28905	28909	28913	28916	28920	28924	28928	1	1
7	28931	28935	28939	28942	28946	28950	28953	28957	28961	28964	28968	28972	2	2
8	28975	28979	28983	28986	28990	28994	28997	29001	29004	29008	29012	29015	3	2
9	29019	29022	29026	29029	29033	29037	29040	29044	29047	29051	29054	29058	4	3
10	5.29061	29065	29068	29072	29075	29079	29082	29086	29089	29092	29096	29099	s	3
11	29103	29106	29110	29113	29116	29120	29123	29127	29130	29133	29137	29140	1	1
12	29143	29147	29150	29154	29157	29160	29163	29167	29170	29173	29177	29180	2	1
13	29183	29187	29190	29193	29196	29200	29203	29206	29209	29213	29216	29219	3	2
14	29222	29226	29229	29232	29235	29238	29241	29245	29248	29251	29254	29257	4	2
15	29260	29264	29267	29270	29273	29276	29279	29282	29285	29288	29292	29295	s	3
16	29298	29301	29304	29307	29310	29313	29316	29319	29322	29325	29328	29331	1	1
17	29334	29337	29340	29343	29346	29349	29352	29355	29358	29361	29364	29367	2	1
18	29370	29373	29375	29378	29381	29384	29387	29390	29393	29396	29399	29401	3	2
19	29404	29407	29410	29413	29416	29419	29421	29424	29427	29430	29433	29435	4	2
20	5.29438	29441	29444	29447	29449	29452	29455	29458	29460	29463	29466	29468	s	3
21	29471	29474	29477	29479	29482	29485	29487	29490	29493	29495	29498	29501	1	1
22	29503	29506	29509	29511	29514	29516	29519	29522	29524	29527	29529	29532	2	1
23	29535	29537	29540	29542	29545	29547	29550	29552	29555	29558	29560	29563	3	2
24	29565	29568	29570	29573	29575	29577	29580	29582	29585	29587	29590	29592	4	2
25	29595	29597	29599	29602	29604	29607	29609	29611	29614	29616	29619	29621	s	2
26	29623	29626	29628	29630	29633	29635	29637	29640	29642	29644	29647	29649	1	0
27	29651	29654	29656	29658	29660	29663	29665	29667	29669	29672	29674	29676	2	1
28	29678	29681	29683	29685	29687	29689	29691	29694	29696	29698	29700	29702	3	1
29	29704	29707	29709	29711	29713	29715	29717	29719	29721	29724	29726	29728	4	2
30	5.29730	29732	29734	29736	29738	29740	29742	29744	29746	29748	29750	29752	s	2
31	29754	29756	29758	29760	29762	29764	29766	29768	29770	29772	29774	29776	1	0
32	29778	29780	29782	29784	29786	29788	29790	29791	29793	29795	29797	29799	2	1
33	29801	29803	29805	29807	29808	29810	29812	29814	29816	29818	29819	29821	3	1
34	29823	29825	29827	29828	29830	29832	29834	29835	29837	29839	29841	29842	4	2
35	29844	29846	29848	29849	29851	29853	29854	29856	29858	29859	29861	29863	s	2
36	29864	29866	29868	29869	29871	29873	29874	29876	29878	29879	29881	29882	1	0
37	29884	29886	29887	29889	29890	29892	29893	29895	29896	29898	29900	29901	2	1
38	29903	29904	29906	29907	29909	29910	29912	29913	29915	29916	29918	29919	3	1
39	29920	29922	29923	29925	29926	29928	29929	29930	29932	29933	29935	29936	4	2
40	5.29937	29939	29940	29942	29943	29944	29946	29947	29948	29950	29951	29952	s	1
41	29954	29955	29956	29958	29959	29960	29961	29963	29964	29965	29966	29968	1	0
42	29969	29970	29971	29973	29974	29975	29976	29978	29979	29980	29981	29982	2	0
43	29983	29985	29986	29987	29988	29989	29990	29992	29993	29994	29995	29996	3	1
44	29997	29998	29999	30000	30001	30003	30004	30005	30006	30007	30008	30009	4	1
45	30010	30011	30012	30013	30014	30015	30016	30017	30018	30019	30020	30021	s	1
46	30022	30023	30024	30025	30026	30027	30028	30029	30029	30030	30031	30032	1	0
47	30033	30034	30035	30036	30037	30038	30038	30039	30040	30041	30042	30043	2	0
48	30043	30044	30045	30046	30047	30048	30048	30049	30050	30051	30051	30052	3	1
49	30053	30054	30054	30055	30056	30057	30057	30058	30059	30060	30060	30061	4	1
50	5.30062	30062	30063	30064	30064	30065	30066	30066	30067	30068	30068	30069	s	1
51	30070	30070	30071	30071	30072	30073	30073	30074	30074	30075	30075	30076	1	0
52	30077	30077	30078	30078	30079	30079	30080	30080	30081	30081	30082	30082	2	0
53	30083	30083	30084	30084	30085	30085	30086	30086	30086	30087	30087	30088	3	0
54	30088	30089	30089	30089	30090	30090	30090	30090	30091	30091	30092	30092	4	1
55	30093	30093	30093	30094	30094	30094	30095	30095	30095	30096	30096	30096	s	1
56	30096	30097	30097	30097	30097	30098	30098	30098	30098	30099	30099	30099	1	0
57	30099	30100	30100	30100	30100	30100	30100	30101	30101	30101	30101	30101	2	0
58	30101	30102	30102	30102	30102	30102	30102	30102	30102	30102	30102	30102	3	0
59	30103	30103	30103	30103	30103	30103	30103	30103	30103	30103	30103	30103	4	1

TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

0 Hour.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	9.				02436	21818	37654	51044	62642	72873	82024	90303		
1	9.97860	04813	11250	17242	22848	28114	33079	37775	42230	46468	50509	54370		
2	0.58066	61612	65019	68297	71455	74503	77448	80296	83054	85726	88319	90837		
3	93284	95664	97980	00236	02435	04580	06673	08717	10714	12666	14575	16443		
4	1.18271	20062	21817	23537	25224	26878	28502	30095	31660	33198	34708	36193		
5	37653	39088	40501	41890	43258	44605	45931	47237	48524	49792	51041	52273		
6	53488	54686	55868	57034	58184	59320	60440	61547	62639	63718	64784	65837		
7	66877	67905	68920	69924	70917	71898	72869	73829	74778	75717	76646	77565		
8	78474	79374	80265	81147	82019	82834	83739	84587	85426	86257	87080	87896		
9	88703	89504	90297	91083	91862	92634	93399	94157	94909	95655	96394	97127		
10	1.97854	98574	99289	99998	00701	01399	02091	02777	03458	04134	04805	05470	s	603
11	2.06131	06786	07437	08082	08723	09359	09991	10618	11240	11859	12472	13082	1	120
12	13687	14288	14885	15477	16066	16651	17232	17809	18382	18951	19517	20079	2	240
13	20638	21192	21744	22292	22836	23377	23915	24449	24980	25508	26033	26554	3	361
14	27073	27588	28100	28609	29116	29619	30120	30617	31112	31604	32093	32579	4	482
15	33063	33544	34023	34498	34972	35442	35910	36376	36839	37299	37758	38213	s	422
16	38667	39118	39567	40013	40457	40899	41339	41776	42211	42644	43075	43504	1	84
17	43930	44355	44777	45198	45616	46033	46447	46859	47270	47678	48085	48490	2	168
18	48893	49294	49693	50090	50486	50879	51271	51661	52050	52436	52821	53205	3	253
19	53586	53966	54344	54721	55096	55469	55841	56211	56580	56947	57313	57670	4	338
20	2.58039	58400	58759	59117	59474	59829	60182	60534	60885	61234	61582	61929	s	326
21	62274	62618	62960	63302	63641	63979	64316	64652	64987	65320	65652	65982	1	65
22	66312	66640	66967	67292	67617	67940	68262	68583	68903	69221	69538	69855	2	131
23	70170	70483	70796	71108	71418	71728	72036	72343	72649	72954	73258	73561	3	196
24	73863	74164	74464	74762	75060	75357	75652	75947	76241	76533	76825	77116	4	261
25	77405	77694	77982	78269	78555	78840	79124	79407	79689	79970	80251	80530	s	265
26	80809	81086	81363	81639	81914	82188	82461	82734	83005	83276	83546	83815	1	53
27	84083	84350	84617	84883	85148	85412	85675	85937	86199	86460	86720	86979	2	106
28	87238	87496	87753	88009	88265	88519	88773	89027	89279	89531	89782	90032	3	159
29	90282	90531	90779	91027	91273	91520	91765	92010	92254	92497	92739	92981	4	212
30	2.93223	93463	93703	93942	94181	94419	94656	94893	95129	95364	95599	95833	s	223
31	96067	96299	96532	96763	96994	97224	97454	97683	97912	98140	98367	98594	1	45
32	98820	99045	99270	99495	99719	99942	00164	00386	00608	00829	01049	01269	2	89
33	3.01488	01707	01925	02143	02360	02576	02792	03008	03222	03437	03651	03864	3	134
34	04077	04289	04501	04712	04922	05133	05342	05551	05760	05968	06176	06383	4	178
35	06590	06796	07001	07207	07411	07616	07819	08023	08225	08428	08629	08831	s	194
36	09032	09232	09432	09632	09831	10029	10227	10425	10622	10819	11015	11211	1	39
37	11406	11601	11796	11990	12184	12377	12570	12762	12954	13146	13337	13527	2	78
38	13718	13908	14097	14286	14475	14663	14850	15038	15225	15411	15597	15783	3	116
39	15969	16154	16338	16522	16706	16889	17072	17255	17437	17619	17800	17982	4	155
40	3.18162	18343	18522	18702	18881	19060	19238	19417	19594	19771	19949	20125	s	171
41	20301	20477	20653	20828	21003	21177	21351	21525	21699	21872	22044	22217	1	34
42	22389	22560	22732	22903	23073	23244	23414	23583	23753	23922	24090	24259	2	68
43	24427	24594	24762	24929	25095	25262	25428	25594	25759	25924	26089	26253	3	103
44	26418	26581	26745	26908	27071	27234	27396	27558	27720	27881	28042	28203	4	137
45	28363	28524	28683	28843	29002	29161	29320	29478	29637	29794	29952	30109	s	153
46	30266	30423	30579	30735	30891	31047	31202	31357	31512	31666	31820	31974	1	31
47	32128	32281	32434	32587	32739	32892	33044	33195	33347	33498	33649	33800	2	61
48	33950	34100	34250	34400	34549	34698	34847	34995	35144	35292	35439	35587	3	92
49	35734	35881	36028	36175	36321	36467	36613	36758	36903	37048	37193	37338	4	122
50	3.37482	37626	37770	37914	38057	38200	38343	38486	38628	38770	38912	39054	s	138
51	39195	39336	39477	39618	39759	39899	40039	40179	40319	40458	40597	40736	1	28
52	40875	41013	41152	41290	41427	41565	41702	41839	41976	42113	42250	42386	2	55
53	42522	42658	42794	42929	43064	43199	43334	43469	43603	43737	43871	44005	3	83
54	44138	44272	44405	44537	44670	44803	44935	45067	45199	45331	45462	45593	4	111
55	45724	45855	45986	46116	46247	46377	46507	46636	46766	46895	47024	47153	s	125
56	47282	47410	47539	47667	47795	47923	48050	48177	48305	48432	48558	48685	1	25
57	48811	48938	49064	49190	49315	49441	49566	49691	49816	49941	50066	50190	2	50
58	50314	50438	50562	50686	50809	50933	51056	51179	51302	51424	51547	51669	3	75
59	51791	51913	52035	52156	52278	52399	52520	52641	52761	52882	53002	53122	4	100

TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

1 Hour.

M	0^s	5^s	10^s	15^s	20^s	25^s	30^s	35^s	40^s	45^s	50^s	55^s	Pro. pts.	
0	3.53243	53362	53482	53602	53721	53840	53959	54078	54197	54315	54434	54552	s	115
1	54670	54788	54905	55023	55140	55258	55375	55492	55608	55725	55841	55958	1	23
2	56074	56190	56306	56421	56537	56652	56767	56882	56997	57112	57226	57341	2	46
3	57455	57569	57683	57797	57910	58024	58137	58250	58363	58476	58589	58702	3	69
4	58814	58926	59038	59150	59262	59374	59486	59597	59708	59819	59930	60041	4	92
5	60152	60262	60373	60483	60593	60703	60813	60923	61032	61143	61251	61360	s	107
6	61469	61578	61686	61795	61903	62012	62120	62228	62336	62443	62551	62659	1	21
7	62766	62873	62980	63087	63194	63301	63407	63513	63620	63726	63832	63938	2	43
8	64043	64149	64254	64360	64465	64570	64675	64780	64885	64989	65094	65198	3	64
9	65302	65406	65510	65614	65717	65821	65924	66028	66131	66234	66337	66440	4	85
10	3.66543	66645	66747	66849	66952	67054	67156	67257	67359	67461	67562	67663	s	99
11	67765	67866	67967	68067	68168	68269	68369	68469	68570	68670	68770	68870	1	20
12	68969	69069	69169	69268	69367	69467	69566	69665	69763	69862	69961	70059	2	40
13	70158	70256	70354	70452	70550	70648	70745	70843	70940	71038	71135	71232	3	60
14	71329	71426	71523	71620	71716	71813	71909	72005	72101	72197	72294	72389	4	80
15	72485	72580	72676	72771	72867	72962	73057	73152	73247	73341	73436	73530	s	92
16	73625	73719	73813	73907	74001	74095	74189	74283	74376	74470	74563	74657	1	17
17	74750	74843	74936	75029	75121	75214	75307	75399	75491	75584	75676	75768	2	37
18	75860	75952	76043	76135	76227	76318	76409	76501	76592	76683	76774	76865	3	55
19	76955	77046	77137	77227	77318	77408	77498	77588	77678	77768	77858	77947	4	73
20	3.78037	78127	78216	78305	78395	78484	78573	78662	78750	78839	78928	79016	s	87
21	79105	79193	79282	79370	79458	79546	79634	79722	79809	79897	79985	80072	1	17
22	80159	80247	80334	80421	80508	80595	80682	80768	80855	80942	81028	81115	2	35
23	81201	81287	81373	81459	81545	81631	81717	81802	81888	81974	82059	82144	3	52
24	82230	82315	82400	82485	82570	82655	82739	82824	82908	82993	83077	83162	4	70
25	83246	83330	83414	83498	83582	83666	83749	83833	83917	84000	84083	84167	s	82
26	84250	84333	84416	84499	84582	84665	84748	84830	84913	84995	85078	85160	1	16
27	85242	85324	85406	85488	85570	85652	85734	85816	85897	85979	86060	86141	2	33
28	86223	86304	86385	86466	86547	86628	86709	86790	86870	86951	87031	87112	3	49
29	87192	87272	87352	87433	87513	87593	87672	87752	87832	87912	87991	88071	4	65
30	3.88150	88229	88309	88388	88467	88546	88625	88704	88783	88862	88940	89019	s	77
31	89097	89176	89254	89333	89411	89489	89567	89645	89723	89801	89879	89956	1	15
32	90034	90112	90189	90267	90344	90421	90498	90576	90653	90730	90807	90884	2	31
33	90960	91037	91114	91190	91267	91343	91420	91496	91572	91648	91724	91800	3	46
34	91876	91952	92028	92104	92179	92255	92331	92406	92482	92557	92632	92707	4	62
35	92782	92858	92933	93007	93082	93157	93232	93306	93381	93456	93530	93605	s	73
36	93679	93753	93827	93901	93975	94049	94123	94197	94271	94345	94418	94492	1	15
37	94566	94639	94712	94786	94859	94932	95005	95078	95152	95224	95297	95370	2	29
38	95443	95515	95588	95661	95733	95806	95878	95950	96023	96095	96167	96239	3	44
39	96311	96383	96455	96527	96599	96670	96742	96813	96885	96956	97028	97099	4	58
40	3.97170	97242	97313	97384	97455	97526	97597	97667	97738	97809	97880	97950	s	70
41	98021	98091	98162	98232	98302	98372	98443	98513	98583	98653	98723	98793	1	14
42	98862	98932	99002	99072	99141	99211	99280	99350	99419	99488	99557	99627	2	28
43	99696	99765	99834	99903	99972	00040	00109	00178	00247	00315	00384	00452	3	42
44	4.00521	00589	00657	00726	00794	00862	00930	00998	01066	01134	01202	01270	4	56
45	01337	01405	01473	01540	01608	01675	01743	01810	01877	01945	02012	02079	s	66
46	02146	02213	02280	02347	02414	02481	02547	02614	02681	02747	02814	02880	1	13
47	02947	03013	03080	03146	03212	03278	03344	03411	03477	03542	03608	03674	2	26
48	03740	03806	03871	03937	04003	04068	04134	04199	04265	04330	04395	04460	3	40
49	04526	04591	04656	04721	04786	04851	04916	04980	05045	05110	05175	05239	4	53
50	4.05304	05368	05433	05497	05561	05626	05690	05754	05818	05882	05946	06010	s	63
51	06074	06138	06202	06266	06330	06393	06457	06521	06584	06648	06711	06775	1	13
52	06838	06901	06965	07028	07091	07154	07217	07280	07343	07406	07469	07532	2	25
53	07595	07657	07720	07783	07845	07908	07970	08033	08095	08157	08220	08282	3	38
54	08344	08406	08468	08530	08592	08654	08716	08778	08840	08902	08964	09025	4	50
55	09087	09148	09210	09272	09333	09394	09456	09517	09578	09640	09701	09762	s	60
56	09823	09884	09945	10006	10067	10128	10188	10249	10310	10371	10431	10492	1	12
57	10552	10613	10673	10734	10794	10854	10915	10975	11035	11095	11155	11215	2	24
58	11275	11335	11395	11455	11515	11575	11634	11694	11754	11813	11873	11932	3	36
59	11992	12051	12111	12170	12229	12289	12348	12407	12466	12525	12584	12643	4	48

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

2 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	4.12702	12761	12820	12879	12938	12996	13055	13114	13172	13231	13289	13348	s	57
1	13406	13465	13523	13581	13640	13698	13756	13814	13872	13931	13989	14047	1	11
2	14104	14162	14220	14278	14336	14394	14451	14508	14567	14625	14682	14739	2	23
3	14797	14854	14911	14969	15026	15083	15140	15198	15255	15312	15369	15426	3	34
4	15483	15540	15597	15653	15710	15767	15824	15880	15937	15994	16050	16107	4	46
5	16163	16220	16276	16332	16389	16445	16501	16557	16614	16670	16726	16782	s	55
6	16838	16894	16950	17006	17062	17117	17173	17229	17285	17340	17396	17451	1	11
7	17507	17563	17618	17673	17729	17784	17840	17895	17950	18005	18060	18116	2	22
8	18171	18226	18281	18336	18391	18445	18500	18555	18610	18665	18719	18774	3	33
9	18829	18883	18938	18992	19047	19101	19156	19210	19265	19319	19373	19427	4	44
10	4.19482	19536	19590	19644	19698	19752	19806	19860	19914	19968	20022	20075	s	53
11	20129	20183	20236	20290	20344	20397	20451	20505	20558	20611	20665	20718	1	11
12	20771	20825	20878	20931	20984	21037	21091	21144	21197	21250	21303	21356	2	21
13	21409	21461	21514	21567	21620	21673	21725	21778	21831	21883	21936	21988	3	32
14	22041	22093	22146	22198	22250	22303	22355	22407	22459	22511	22564	22616	4	42
15	22668	22720	22772	22824	22876	22928	22980	23031	23083	23135	23187	23238	s	51
16	23290	23342	23393	23445	23496	23548	23599	23651	23702	23754	23805	23856	1	10
17	23907	23959	24010	24061	24112	24163	24214	24265	24316	24367	24418	24469	2	20
18	24520	24571	24622	24673	24723	24774	24825	24875	24926	24977	25027	25078	3	31
19	25128	25178	25229	25279	25330	25380	25430	25481	25531	25581	25631	25681	4	41
20	4.25731	25781	25831	25881	25931	25981	26031	26081	26131	26181	26231	26281	s	49
21	26330	26380	26429	26479	26529	26578	26628	26677	26727	26776	26826	26875	1	10
22	26924	26974	27023	27072	27121	27171	27220	27269	27318	27367	27416	27465	2	20
23	27514	27563	27612	27661	27710	27759	27807	27856	27905	27954	28002	28051	3	29
24	28099	28148	28197	28245	28294	28342	28391	28439	28487	28536	28584	28632	4	39
25	28681	28729	28777	28825	28873	28921	28969	29017	29066	29114	29161	29209	s	47
26	29257	29305	29353	29401	29449	29496	29544	29592	29639	29687	29735	29782	1	9
27	29830	29877	29925	29973	30020	30067	30115	30162	30209	30257	30304	30351	2	19
28	30398	30445	30493	30540	30587	30634	30681	30728	30775	30822	30869	30916	3	28
29	30963	31009	31056	31103	31150	31197	31243	31290	31337	31383	31430	31476	4	36
30	4.31523	31569	31616	31662	31709	31755	31801	31848	31894	31940	31987	32033	s	45
31	32079	32125	32171	32217	32264	32310	32356	32402	32448	32494	32540	32586	1	9
32	32631	32677	32723	32769	32815	32860	32906	32952	32997	33043	33089	33134	2	18
33	33180	33225	33271	33316	33362	33407	33453	33498	33543	33589	33634	33679	3	27
34	33724	33770	33815	33860	33905	33950	33995	34040	34085	34130	34175	34220	4	36
35	34265	34310	34355	34400	34444	34489	34534	34579	34623	34668	34713	34757	s	44
36	34802	34847	34891	34936	34980	35025	35069	35114	35158	35202	35247	35291	1	9
37	35335	35380	35424	35468	35512	35556	35601	35645	35689	35733	35777	35821	2	18
38	35865	35909	35953	35997	36041	36085	36128	36172	36216	36260	36303	36347	3	27
39	36391	36435	36478	36522	36565	36609	36653	36696	36740	36783	36827	36870	4	35
40	4.36913	36957	37000	37043	37087	37130	37173	37216	37260	37303	37346	37389	s	43
41	37432	37475	37518	37561	37604	37647	37690	37733	37776	37819	37862	37905	1	9
42	37948	37990	38033	38076	38119	38161	38204	38247	38289	38332	38374	38417	2	17
43	38460	38502	38545	38587	38629	38672	38714	38757	38799	38841	38884	38920	3	26
44	38968	39010	39052	39095	39137	39179	39221	39263	39305	39347	39389	39431	4	34
45	39473	39515	39557	39599	39641	39683	39725	39766	39808	39850	39892	39933	s	41
46	39975	40017	40058	40100	40142	40183	40225	40266	40308	40349	40391	40432	1	8
47	40474	40515	40556	40598	40639	40680	40722	40763	40804	40845	40887	40928	2	16
48	40969	41010	41051	41092	41133	41174	41215	41256	41297	41338	41379	41420	3	25
49	41461	41502	41543	41583	41624	41665	41706	41746	41787	41828	41868	41909	4	33
50	4.41950	41990	42031	42071	42112	42153	42193	42233	42274	42314	42355	42395	s	40
51	42435	42476	42516	42556	42597	42637	42677	42717	42758	42798	42838	42878	1	8
52	42918	42958	42998	43038	43078	43118	43158	43198	43238	43278	43318	43358	2	16
53	43398	43437	43477	43517	43557	43597	43636	43676	43716	43755	43795	43835	3	24
54	43874	43914	43953	43993	44032	44072	44111	44151	44190	44229	44269	44308	4	32
55	44348	44387	44426	44465	44505	44544	44583	44622	44662	44701	44740	44779	s	39
56	44818	44857	44896	44935	44974	45013	45052	45091	45130	45169	45208	45247	1	8
57	45286	45325	45363	45402	45441	45480	45518	45557	45596	45634	45673	45712	2	16
58	45750	45789	45827	45866	45905	45943	45982	46020	46058	46097	46135	46174	3	23
59	46212	46250	46289	46327	46365	46404	46442	46480	46518	46556	46595	46633	4	31

TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

3 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	4.46671	46709	46747	46785	46823	46861	46899	46937	46975	47013	47051	47089	s	38
1	47127	47165	47203	47241	47278	47316	47354	47392	47430	47467	47505	47543	1	8
2	47580	47618	47656	47693	47731	47768	47806	47843	47881	47918	47956	47993	2	15
3	48031	48068	48106	48143	48180	48218	48255	48292	48330	48367	48404	48441	3	23
4	48479	48516	48553	48590	48627	48664	48701	48739	48776	48813	48850	48887	4	30
5	48924	48961	48998	49035	49071	49108	49145	49182	49219	49256	49293	49329	s	36
6	49366	49403	49440	49476	49513	49550	49586	49623	49660	49696	49733	49769	1	7
7	49806	49842	49879	49915	49952	49988	50025	50061	50098	50134	50170	50207	2	15
8	50243	50279	50316	50342	50388	50424	50461	50497	50533	50569	50605	50641	3	22
9	50677	50714	50750	50786	50822	50858	50894	50930	50966	51002	51038	51073	4	29
10	4.51109	51145	51181	51217	51253	51289	51324	51360	51396	51432	51467	51503	s	35
11	51539	51574	51610	51646	51681	51717	51753	51788	51824	51859	51895	51930	1	7
12	51966	52001	52037	52072	52107	52143	52178	52213	52249	52284	52319	52355	2	14
13	52390	52425	52461	52496	52531	52566	52601	52636	52672	52707	52742	52777	3	21
14	52812	52847	52882	52917	52952	52987	53022	53057	53092	53127	53162	53197	4	28
15	53231	53266	53301	53336	53371	53405	53440	53475	53510	53544	53579	53614	s	34
16	53648	53683	53718	53752	53787	53821	53856	53891	53925	53960	53994	54029	1	7
17	54063	54097	54132	54166	54201	54235	54269	54304	54338	54372	54407	54441	2	14
18	54475	54509	54544	54578	54612	54646	54680	54715	54749	54783	54817	54851	3	20
19	54885	54919	54953	54987	55021	55055	55089	55123	55157	55191	55225	55259	4	26
20	4.55293	55327	55360	55394	55428	55462	55496	55529	55563	55597	55630	55664	s	33
21	55698	55732	55765	55799	55832	55866	55900	55933	55967	56000	56034	56067	1	7
22	56101	56134	56168	56201	56235	56268	56301	56335	56368	56401	56435	56468	2	13
23	56501	56534	56568	56601	56635	56668	56701	56734	56767	56800	56834	56867	3	20
24	56900	56933	56966	56999	57032	57065	57098	57131	57164	57197	57230	57263	4	27
25	57296	57329	57362	57395	57428	57460	57493	57526	57559	57592	57625	57657	s	32
26	57690	57723	57755	57788	57821	57854	57886	57919	57951	57984	58017	58049	1	6
27	58082	58114	58147	58179	58212	58244	58277	58309	58342	58374	58407	58439	2	13
28	58471	58504	58536	58568	58601	58633	58665	58698	58730	58762	58794	58827	3	19
29	58859	58891	58923	58955	58988	59020	59052	59084	59116	59148	59180	59212	4	26
30	4.59244	59276	59308	59340	59372	59404	59436	59468	59500	59532	59564	59596	s	32
31	59627	59659	59691	59723	59755	59786	59818	59850	59882	59913	59945	59977	1	6
32	60008	60040	60072	60103	60135	60167	60198	60230	60261	60293	60324	60356	2	13
33	60388	60419	60450	60482	60513	60545	60576	60608	60639	60670	60701	60733	3	19
34	60764	60796	60827	60858	60890	60921	60952	60983	61015	61046	61077	61108	4	26
35	61139	61171	61202	61233	61264	61295	61326	61357	61388	61419	61450	61481	s	31
36	61512	61543	61574	61605	61636	61667	61698	61729	61760	61791	61822	61852	1	6
37	61883	61914	61945	61976	62006	62037	62068	62099	62129	62160	62191	62222	2	12
38	62252	62283	62313	62344	62375	62405	62436	62466	62497	62528	62558	62589	3	19
39	62619	62650	62680	62711	62741	62771	62802	62832	62863	62893	62923	62954	4	25
40	4.62984	63014	63045	63075	63105	63136	63166	63196	63226	63257	63287	63317	s	30
41	63347	63377	63407	63438	63468	63498	63528	63558	63588	63618	63648	63678	1	6
42	63708	63738	63768	63798	63828	63858	63888	63918	63948	63978	64008	64038	2	12
43	64068	64097	64127	64157	64187	64217	64246	64276	64306	64336	64365	64395	3	18
44	64425	64455	64484	64514	64544	64573	64603	64632	64662	64692	64721	64751	4	24
45	64780	64810	64839	64869	64898	64928	64957	64987	65016	65045	65075	65105	s	29
46	65134	65163	65193	65222	65251	65281	65310	65339	65369	65398	65427	65456	1	6
47	65486	65515	65544	65573	65603	65632	65661	65690	65719	65748	65777	65806	2	12
48	65836	65865	65894	65923	65952	65981	66010	66039	66068	66097	66126	66155	3	17
49	66184	66213	66242	66270	66299	66328	66357	66386	66415	66444	66472	66501	4	23
50	4.66530	66559	66588	66616	66645	66674	66702	66731	66760	66789	66817	66846	s	29
51	66875	66903	66932	66960	66989	67018	67046	67075	67103	67132	67160	67189	1	6
52	67217	67246	67274	67303	67331	67360	67388	67416	67445	67473	67502	67530	2	12
53	67558	67587	67615	67643	67672	67700	67728	67756	67785	67813	67841	67869	3	17
54	67897	67925	67954	67982	68010	68038	68066	68094	68123	68151	68179	68207	4	23
55	68235	68263	68291	68319	68347	68375	68403	68431	68459	68487	68515	68543	s	28
56	68571	68599	68627	68654	68682	68710	68738	68766	68794	68821	68849	68877	1	6
57	68905	68933	68960	68988	69016	69043	69071	69099	69127	69154	69182	69210	2	11
58	69237	69265	69292	69320	69348	69375	69403	69430	69458	69486	69513	69540	3	17
59	69568	69595	69623	69650	69678	69705	69733	69760	69788	69815	69842	69870	4	22

TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

4 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	4.69897	69924	69952	69979	70006	70034	70061	70088	70115	70143	70170	70197	s	27
1	70224	70252	70279	70306	70333	70360	70387	70415	70442	70469	70496	70523	1	5
2	70550	70577	70604	70631	70658	70685	70712	70739	70766	70793	70820	70847	2	11
3	70874	70901	70928	70955	70982	71009	71036	71063	71089	71116	71143	71170	3	16
4	71197	71224	71250	71277	71304	71331	71357	71384	71411	71438	71464	71491	4	22
5	71518	71544	71571	71598	71624	71651	71678	71704	71731	71757	71784	71810	s	26
6	71837	71864	71890	71917	71943	71970	71996	72023	72049	72075	72102	72128	1	5
7	72155	72181	72208	72234	72260	72287	72313	72339	72366	72392	72418	72445	2	11
8	72471	72497	72523	72550	72576	72602	72628	72655	72681	72707	72733	72759	3	16
9	72785	72812	72838	72864	72890	72916	72942	72968	72994	73020	73046	73072	4	21
10	4.73099	73125	73151	73177	73203	73228	73254	73280	73306	73332	73358	73384	s	26
11	73410	73436	73462	73488	73514	73539	73565	73591	73617	73643	73668	73694	1	5
12	73720	73746	73772	73797	73823	73849	73874	73900	73926	73951	73977	74003	2	10
13	74028	74054	74080	74105	74131	74157	74182	74208	74233	74259	74284	74310	3	16
14	74335	74361	74386	74412	74437	74463	74488	74514	74539	74565	74590	74616	4	21
15	74641	74666	74692	74717	74742	74768	74793	74818	74844	74869	74894	74920	s	25
16	74945	74970	74995	75021	75046	75071	75096	75122	75147	75172	75197	75222	1	5
17	75247	75273	75298	75323	75348	75373	75398	75423	75448	75473	75498	75523	2	10
18	75549	75574	75599	75624	75649	75674	75699	75723	75748	75773	75798	75823	3	15
19	75848	75873	75898	75923	75948	75973	75997	76022	76047	76072	76097	76121	4	20
20	4.76146	76171	76196	76221	76245	76270	76295	76320	76344	76369	76394	76418	s	25
21	76443	76468	76492	76517	76542	76566	76591	76615	76640	76665	76689	76714	1	5
22	76738	76763	76787	76812	76836	76861	76885	76910	76934	76959	76983	77008	2	10
23	77032	77057	77081	77105	77130	77154	77179	77203	77227	77252	77276	77300	3	15
24	77325	77349	77373	77398	77422	77446	77470	77495	77519	77543	77567	77592	4	20
25	77616	77640	77664	77688	77713	77737	77761	77785	77809	77833	77857	77882	s	24
26	77906	77930	77954	77978	78002	78026	78050	78074	78098	78122	78146	78170	1	5
27	78194	78218	78242	78266	78290	78314	78338	78361	78385	78409	78433	78457	2	10
28	78481	78505	78529	78552	78576	78600	78624	78648	78671	78695	78719	78743	3	15
29	78767	78790	78814	78838	78861	78885	78909	78933	78956	78980	79004	79027	4	19
30	4.79051	79074	79098	79122	79145	79169	79192	79216	79240	79263	79287	79310	s	23
31	79334	79357	79381	79404	79428	79451	79475	79498	79522	79545	79568	79592	1	5
32	79615	79639	79662	79686	79709	79732	79756	79779	79802	79826	79849	79872	2	9
33	79896	79919	79942	79965	79989	80012	80035	80059	80082	80105	80128	80151	3	14
34	80175	80198	80221	80244	80267	80290	80314	80337	80360	80383	80406	80429	4	19
35	80452	80475	80498	80521	80545	80568	80591	80614	80637	80660	80683	80706	s	23
36	80729	80752	80775	80797	80820	80843	80866	80889	80912	80935	80958	80981	1	5
37	81004	81027	81049	81072	81095	81118	81141	81163	81186	81209	81232	81255	2	9
38	81277	81300	81323	81346	81368	81391	81414	81437	81459	81482	81505	81527	3	14
39	81550	81573	81595	81618	81641	81663	81686	81708	81731	81754	81776	81799	4	18
40	4.81821	81844	81866	81889	81911	81934	81956	81979	82001	82024	82046	82069	s	22
41	82091	82114	82136	82159	82181	82203	82226	82248	82271	82293	82315	82338	1	4
42	82360	82382	82405	82427	82449	82472	82494	82516	82538	82561	82583	82605	2	9
43	82628	82650	82672	82694	82716	82739	82761	82783	82805	82827	82850	82872	3	13
44	82894	82916	82938	82960	82982	83004	83026	83049	83071	83093	83115	83137	4	19
45	83159	83181	83203	83225	83247	83269	83291	83313	83335	83357	83379	83401	s	22
46	83423	83445	83467	83488	83510	83532	83554	83576	83598	83620	83642	83664	1	4
47	83685	83707	83729	83751	83773	83794	83816	83838	83860	83881	83903	83925	2	9
48	83947	83968	83990	84012	84033	84055	84077	84098	84120	84142	84164	84185	3	13
49	84207	84229	84250	84272	84293	84315	84337	84358	84380	84401	84423	84444	4	17
50	4.84466	84488	84509	84531	84552	84574	84595	84617	84638	84659	84681	84702	s	21
51	84724	84745	84767	84788	84810	84831	84852	84874	84895	84916	84938	84959	1	4
52	84981	85002	85023	85044	85066	85087	85108	85130	85151	85172	85194	85215	2	8
53	85236	85257	85278	85300	85321	85342	85363	85385	85406	85427	85448	85469	3	13
54	85490	85512	85533	85554	85575	85596	85617	85638	85659	85680	85701	85722	4	17
55	85744	85765	85786	85807	85828	85849	85870	85891	85912	85933	85954	85975	s	21
56	85996	86017	86038	86058	86079	86100	86121	86142	86163	86184	86205	86226	1	4
57	86247	86267	86288	86309	86330	86351	86372	86392	86413	86434	86455	86475	2	8
58	86496	86517	86538	86559	86579	86600	86621	86641	86662	86683	86704	86724	3	12
59	86745	86766	86786	86807	86828	86848	86869	86889	86910	86931	86951	86972	4	17

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

5 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	4.86992	87013	87034	87054	87075	87095	87116	87136	87157	87177	87198	87218	s	20
1	87239	87259	87280	87300	87321	87341	87362	87382	87402	87423	87443	87464	1	4
2	87484	87505	87525	87545	87566	87586	87606	87627	87647	87667	87688	87708	2	8
3	87728	87749	87769	87789	87809	87830	87850	87870	87890	87911	87931	87951	3	12
4	87971	87992	88012	88032	88052	88072	88093	88113	88133	88153	88173	88193	4	16
5	88213	88234	88254	88274	88294	88314	88334	88354	88374	88394	88414	88434	s	20
6	88454	88474	88494	88514	88534	88554	88574	88594	88614	88634	88654	88674	1	4
7	88694	88714	88734	88754	88774	88794	88814	88834	88853	88873	88893	88913	2	8
8	88933	88953	88973	88992	89012	89032	89052	89072	89091	89111	89131	89151	3	12
9	89171	89190	89210	89230	89250	89269	89289	89309	89328	89348	89368	89388	4	16
10	4.89407	89427	89447	89466	89486	89506	89525	89545	89564	89584	89604	89623	s	19
11	89643	89662	89682	89702	89721	89741	89760	89780	89799	89819	89838	89858	1	4
12	89877	89897	89916	89936	89955	89975	89994	90014	90033	90053	90072	90091	2	8
13	90111	90130	90150	90169	90188	90208	90227	90247	90266	90285	90305	90324	3	12
14	90343	90363	90382	90401	90421	90440	90459	90478	90498	90517	90536	90555	4	16
15	90575	90594	90613	90632	90652	90671	90690	90709	90728	90748	90767	90786	s	19
16	90805	90824	90843	90863	90882	90901	90920	90939	90958	90977	90996	91015	1	4
17	91034	91054	91073	91092	91111	91130	91149	91168	91187	91206	91225	91244	2	8
18	91263	91282	91301	91320	91339	91358	91377	91396	91414	91433	91452	91471	3	11
19	91490	91509	91528	91547	91566	91585	91603	91622	91641	91660	91679	91698	4	15
20	4.91716	91735	91754	91773	91792	91811	91829	91848	91867	91886	91904	91923	s	18
21	91942	91961	91979	91998	92017	92035	92054	92073	92092	92110	92129	92148	1	4
22	92166	92185	92203	92222	92241	92259	92278	92297	92315	92334	92352	92371	2	8
23	92390	92408	92427	92445	92464	92483	92501	92519	92538	92556	92575	92593	3	11
24	92612	92630	92649	92667	92686	92704	92723	92741	92760	92778	92796	92815	4	15
25	92833	92851	92870	92888	92907	92925	92944	92962	92980	92999	93017	93035	s	18
26	93054	93072	93090	93109	93127	93145	93164	93182	93200	93218	93237	93255	1	4
27	93273	93291	93310	93328	93346	93364	93382	93401	93419	93437	93455	93473	2	7
28	93492	93510	93528	93546	93564	93582	93600	93619	93637	93655	93673	93691	3	11
29	93709	93727	93745	93763	93781	93809	93817	93836	93854	93872	93890	93908	4	14
30	4.93926	93944	93962	93980	93998	94016	94034	94052	94069	94088	94105	94123	s	18
31	94141	94159	94177	94195	94213	94231	94249	94267	94284	94302	94320	94338	1	4
32	94356	94374	94392	94410	94427	94445	94463	94481	94498	94516	94534	94552	2	7
33	94570	94587	94605	94623	94641	94658	94676	94694	94711	94729	94747	94765	3	11
34	94782	94800	94818	94835	94853	94871	94888	94906	94924	94941	94959	94976	4	14
35	94994	95012	95029	95047	95065	95082	95100	95117	95135	95153	95170	95188	s	17
36	95205	95223	95240	95258	95275	95293	95310	95328	95345	95363	95380	95398	1	3
37	95415	95433	95450	95468	95485	95502	95520	95537	95555	95572	95589	95607	2	7
38	95624	95642	95659	95676	95694	95711	95728	95746	95763	95780	95798	95815	3	10
39	95832	95850	95867	95884	95902	95919	95936	95953	95971	95988	96005	96022	4	15
40	4.96040	96057	96074	96091	96109	96126	96143	96160	96177	96195	96212	96229	s	17
41	96246	96263	96280	96297	96315	96332	96349	96366	96383	96400	96417	96434	1	3
42	96451	96469	96486	96503	96520	96537	96554	96571	96588	96605	96622	96639	2	7
43	96656	96673	96690	96707	96724	96741	96758	96775	96792	96809	96826	96843	3	10
44	96860	96877	96894	96910	96927	96944	96961	96978	96995	97012	97029	97046	4	14
45	97062	97079	97096	97113	97130	97147	97163	97180	97197	97214	97231	97247	s	17
46	97264	97281	97298	97315	97331	97348	97365	97382	97398	97415	97432	97449	1	3
47	97465	97482	97499	97515	97532	97549	97565	97582	97599	97615	97632	97649	2	7
48	97665	97682	97699	97715	97732	97749	97765	97782	97798	97815	97832	97848	3	10
49	97865	97881	97898	97914	97931	97947	97964	97981	97997	98014	98030	98047	4	13
50	4.98063	98080	98096	98113	98129	98145	98162	98178	98195	98211	98228	98244	s	16
51	98261	98277	98293	98310	98326	98343	98359	98375	98392	98408	98425	98441	1	3
52	98457	98474	98490	98506	98523	98539	98555	98572	98588	98604	98620	98637	2	7
53	98653	98669	98686	98702	98718	98734	98751	98767	98783	98799	98816	98832	3	10
54	98848	98864	98880	98897	98913	98929	98945	98961	98977	98994	99010	99026	4	13
55	99042	99058	99074	99090	99107	99123	99139	99155	99171	99187	99203	99219	s	16
56	99235	99251	99267	99284	99300	99316	99332	99348	99364	99380	99396	99312	1	3
57	99428	99444	99460	99476	99492	99508	99524	99540	99556	99572	99587	99603	2	6
58	99619	99635	99651	99667	99683	99799	99715	99731	99747	99763	99778	99794	3	10
59	99810	99826	99842	99858	99873	99889	99905	99921	99937	99953	99968	99984	4	13

TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

6 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.
0	5.00000	00016	00032	00047	00063	00079	00095	00110	00126	00142	00158	00173	s 16
1	00189	00205	00221	00236	00252	00268	00283	00299	00315	00330	00346	00362	1 3
2	00377	00393	00409	00424	00440	00456	00471	00487	00502	00518	00534	00549	2 6
3	00565	00580	00596	00612	00627	00643	00658	00674	00689	00705	00720	00736	3 9
4	00751	00767	00782	00798	00813	00829	00844	00860	00875	00891	00906	00922	4 12
5	00937	00953	00968	00984	00999	01014	01030	01045	01061	01076	01091	01107	s 15
6	01122	01138	01153	01168	01184	01199	01214	01230	01245	01260	01276	01291	1 3
7	01306	01322	01337	01352	01368	01383	01398	01413	01429	01444	01459	01474	2 6
8	01490	01505	01520	01536	01551	01566	01581	01596	01612	01627	01642	01657	3 9
9	01672	01688	01703	01718	01733	01748	01763	01779	01794	01809	01824	01839	4 12
10	5.01854	01869	01884	01900	01915	01930	01945	01960	01975	01990	02005	02020	s 15
11	02035	02050	02065	02080	02095	02110	02125	02140	02155	02170	02185	02200	1 3
12	02215	02230	02245	02260	02275	02290	02305	02320	02335	02350	02365	02380	2 6
13	02395	02410	02425	02440	02455	02469	02484	02499	02514	02529	02544	02559	3 9
14	02574	02588	02603	02618	02633	02648	02663	02677	02692	02707	02722	02737	4 12
15	02751	02766	02781	02796	02811	02825	02840	02855	02870	02884	02899	02914	s 15
16	02928	02943	02958	02973	02987	03002	03017	03031	03046	03061	03075	03090	1 3
17	03105	03119	03134	03149	03163	03178	03193	03207	03222	03237	03251	03266	2 6
18	03280	03295	03310	03324	03339	03353	03368	03382	03397	03412	03426	03441	3 9
19	03455	03470	03484	03499	03513	03528	03542	03557	03571	03586	03600	03615	4 12
20	5.03629	03644	03658	03672	03687	03701	03716	03730	03745	03759	03774	03788	s 14
21	03802	03817	03831	03846	03860	03874	03889	03903	03918	03932	03946	03961	1 3
22	03975	03989	04004	04018	04032	04047	04061	04075	04090	04104	04118	04132	2 6
23	04147	04161	04175	04190	04204	04218	04232	04247	04261	04275	04289	04303	3 9
24	04318	04332	04346	04360	04375	04389	04403	04417	04431	04445	04460	04474	4 12
25	04488	04502	04516	04530	04545	04559	04573	04587	04601	04615	04629	04643	s 14
26	04657	04672	04686	04700	04714	04728	04742	04756	04770	04784	04798	04812	1 3
27	04826	04840	04854	04868	04882	04896	04910	04924	04938	04952	04966	04980	2 6
28	04994	05008	05022	05036	05050	05064	05078	05092	05106	05120	05134	05148	3 9
29	05162	05175	05189	05203	05217	05231	05245	05259	05273	05286	05300	05314	4 11
30	5.05328	05342	05356	05370	05383	05397	05411	05425	05439	05452	05466	05480	s 14
31	05494	05508	05521	05535	05549	05563	05577	05590	05604	05618	05632	05645	1 3
32	05659	05673	05686	05700	05714	05728	05741	05755	05769	05782	05796	05810	2 6
33	05823	05837	05851	05864	05878	05892	05905	05919	05933	05946	05960	05973	3 8
34	05987	06001	06014	06028	06041	06055	06069	06082	06096	06109	06123	06136	4 11
35	00150	06163	06177	06191	06204	06218	06231	06245	06258	06272	06285	06299	s 13
36	06312	06326	06339	06353	06366	06379	06393	06406	06420	06433	06447	06460	1 3
37	06474	06487	06500	06514	06527	06541	06554	06567	06581	06594	06608	06621	2 5
38	06634	06648	06661	06674	06688	06701	06714	06728	06741	06754	06768	06781	3 8
39	06794	06808	06821	06834	06848	06861	06874	06887	06901	06914	06927	06941	4 11
40	5.06954	06967	06980	06994	07007	07020	07033	07046	07060	07073	07086	07099	s 13
41	07112	07126	07139	07152	07165	07178	07192	07205	07218	07231	07244	07257	1 3
42	07270	07284	07297	07310	07323	07336	07349	07362	07375	07388	07401	07415	2 5
43	07428	07441	07454	07467	07480	07493	07506	07519	07532	07545	07558	07571	3 8
44	07584	07597	07610	07623	07636	07649	07662	07675	07688	07701	07714	07727	4 10
45	07740	07753	07766	07779	07792	07805	07818	07831	07844	07857	07869	07882	s 13
46	07895	07908	07921	07934	07947	07960	07973	07985	07998	08011	08024	08037	1 3
47	08050	08063	08075	08088	08101	08114	08127	08140	08152	08165	08178	08191	2 5
48	08204	08216	08229	08242	08255	08267	08280	08293	08306	08318	08331	08344	3 8
49	08357	08369	08382	08395	08408	08420	08433	08446	08458	08471	08484	08496	4 10
50	5.08509	08522	08534	08547	08560	08572	08585	08598	08610	08623	08636	08648	s 13
51	08661	08673	08686	08699	08711	08724	08736	08749	08762	08774	08787	08799	1 3
52	08812	08824	08837	08850	08862	08875	08887	08900	08912	08925	08937	08950	2 5
53	08962	08975	08987	09000	09012	09025	09037	09050	09062	09075	09087	09100	3 8
54	09112	09124	09137	09149	09162	09174	09187	09199	09211	09224	09236	09249	4 10
55	09261	09273	09286	09298	09311	09323	09335	09348	09360	09372	09385	09397	s 12
56	09409	09422	09434	09446	09459	09471	09483	09496	09508	09520	09533	09545	1 2
57	09557	09569	09582	09594	09606	09618	09631	09643	09655	09667	09680	09692	2 5
58	09704	09716	09729	09741	09753	09765	09777	09790	09802	09814	09826	09838	3 7
59	09851	09863	09875	09887	09899	09911	09924	09936	09948	09960	09972	09984	4 10

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

7 Hours.

M	0^s	5^s	10^s	15^s	20^s	25^s	30^s	35^s	40^s	45^s	50^s	55^s	Pro. pts.
0	5.09996	10008	10021	10033	10045	10057	10069	10081	10093	10105	10117	10129	s 12
1	10141	10153	10166	10178	10190	10202	10214	10226	10238	10250	10262	10274	1 2
2	10286	10298	10310	10322	10334	10346	10358	10370	10382	10394	10406	10418	2 5
3	10430	10441	10454	10465	10477	10489	10501	10513	10525	10537	10549	10561	3 7
4	10573	10585	10597	10608	10620	10632	10644	10656	10668	10680	10691	10703	4 10
5	10715	10727	10739	10751	10763	10774	10786	10798	10810	10822	10833	10845	s 12
6	10857	10869	10881	10893	10904	10916	10928	10940	10951	10963	10975	10986	1 2
7	10998	11010	11022	11033	11045	11057	11069	11080	11092	11104	11115	11127	2 5
8	11139	11150	11162	11174	11185	11197	11209	11220	11232	11244	11255	11267	3 7
9	11279	11290	11302	11314	11325	11337	11348	11360	11372	11383	11395	11406	4 10
10	5.11418	11429	11441	11453	11464	11476	11487	11499	11510	11522	11533	11545	s 12
11	11557	11568	11580	11591	11603	11614	11026	11637	11649	11660	11672	11683	1 2
12	11695	11706	11717	11729	11740	11752	11763	11775	11786	11798	11809	11820	2 5
13	11832	11843	11855	11866	11878	11889	11900	11912	11923	11934	11946	11957	3 7
14	11969	11980	11991	12003	12014	12025	12037	12048	12059	12071	12082	12093	4 9
15	12105	12116	12127	12139	12150	12161	12173	12184	12195	12206	12218	12229	s 11
16	12240	12251	12263	12274	12285	12296	12308	12319	12330	12341	12353	12364	1 2
17	12375	12386	12397	12409	12420	12431	12442	12453	12465	12476	12487	12498	2 5
18	12509	12520	12532	12543	12554	12565	12576	12587	12598	12610	12621	12632	3 7
19	12643	12654	12665	12676	12687	12698	12709	12721	12732	12743	12754	12765	4 9
20	5.12776	12787	12798	12809	12820	12831	12842	12853	12864	12875	12886	12897	s 11
21	12908	12919	12930	12941	12952	12963	12974	12985	12996	13007	13018	13029	1 2
22	13040	13051	13062	13073	13084	13095	13106	13117	13128	13139	13149	13160	2 4
23	13171	13182	13193	13204	13215	13226	13237	13248	13258	13269	13280	13291	3 7
24	13302	13313	13323	13334	13345	13356	13367	13378	13388	13399	13410	13421	4 9
25	13432	13442	13453	13464	13475	13486	13496	13507	13518	13529	13539	13550	s 11
26	13561	13572	13582	13593	13604	13615	13625	13636	13647	13658	13668	13679	1 2
27	13690	13700	13711	13722	13732	13743	13754	13765	13775	13786	13797	13807	2 4
28	13818	13828	13839	13850	13860	13871	13882	13892	13903	13914	13924	13935	3 7
29	13945	13956	13967	13977	13988	13998	14009	14019	14030	14041	14051	14062	4 9
30	5.14072	14083	14093	14104	14114	14125	14136	14146	14157	14167	14178	14188	s 11
31	14199	14209	14220	14230	14241	14251	14262	14272	14282	14293	14303	14314	1 2
32	14324	14335	14345	14356	14366	14377	14387	14397	14408	14418	14429	14439	2 4
33	14449	14460	14470	14481	14491	14501	14512	14522	14533	14543	14553	14564	3 6
34	14574	14584	14595	14605	14615	14626	14636	14646	14657	14667	14677	14688	4 9
35	14698	14708	14719	14729	14739	14750	14760	14770	14780	14790	14801	14811	s 10
36	14821	14832	14842	14852	14862	14872	14883	14893	14903	14913	14924	14934	1 2
37	14944	14954	14964	14975	14985	14995	15005	15015	15026	15036	15046	15056	2 4
38	15066	15076	15087	15097	15107	15117	15127	15137	15147	15157	15168	15178	3 6
39	15188	15198	15208	15218	15228	15238	15248	15258	15269	15279	15289	15299	4 8
40	5.15309	15319	15329	15339	15349	15359	15369	15379	15389	15399	15409	15419	s 10
41	15429	15439	15449	15459	15469	15479	15489	15499	15509	15519	15529	15539	1 2
42	15549	15559	15569	15579	15589	15599	15609	15619	15629	15639	15649	15659	2 4
43	15668	15678	15688	15698	15708	15718	15728	15738	15748	15758	15767	15777	3 6
44	15787	15797	15807	15817	15827	15837	15846	15856	15866	15876	15886	15896	4 8
45	15905	15915	15925	15935	15944	15954	15964	15974	15984	15993	16003	16013	s 10
46	16023	16033	16042	16052	16062	16072	16081	16091	16101	16111	16120	16130	1 2
47	16140	16149	16159	16169	16179	16188	16198	16208	16217	16227	16237	16246	2 4
48	16256	16266	16276	16285	16295	16304	16314	16324	16333	16343	16353	16362	3 6
49	16372	16382	16391	16401	16410	16420	16430	16439	16449	16459	16468	16478	4 8
50	5.16487	16497	16506	16516	16526	16535	16545	16554	16564	16573	16583	16592	s 10
51	16602	16612	16621	16631	16640	16650	16659	16669	16678	16688	16697	16707	1 2
52	16716	16726	16735	16745	16754	16764	16773	16782	16792	16801	16811	16820	2 4
53	16830	16839	16849	16858	16867	16877	16886	16896	16905	16915	16924	16933	3 6
54	16943	16952	16961	16971	16980	16990	16999	17008	17018	17027	17036	17046	4 8
55	17055	17065	17074	17083	17093	17102	17111	17121	17130	17139	17148	17158	s 9
56	17167	17176	17186	17195	17204	17214	17223	17232	17241	17251	17260	17269	1 2
57	17278	17288	17297	17306	17315	17325	17334	17343	17352	17362	17371	17380	2 4
58	17389	17398	17408	17417	17426	17435	17444	17454	17463	17472	17481	17490	3 6
59	17499	17509	17518	17527	17536	17545	17554	17563	17573	17582	17591	17600	4 8

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽ App altit.		Horizontal Parallax.																Prop. parts for Seconds of Par.										
		54′		55′		56′		57′		58′		59′		60′		61′			0″	1″	2″	3″	4″	5″	6″	7″	8″	9″
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″	″	″	″	″	″
3	0	39	21	40	20	41	20	42	20	43	20	44	20	45	20	46	20	0	0	1	2	3	4	5	6	7	8	9
	10	39	52	40	52	41	52	42	52	43	51	44	51	45	51	46	51	10	10	11	12	13	14	15	16	17	18	19
	20	40	21	41	21	42	21	43	21	44	21	45	21	46	21	47	20	20	20	21	22	23	24	25	26	27	28	29
	30	40	49	41	49	42	48	43	48	44	48	45	48	46	48	47	48	30	30	31	32	33	34	35	36	37	38	39
	40	41	15	42	14	43	14	44	14	45	14	46	14	47	14	48	14	40	40	41	42	43	44	45	46	47	48	49
	50	41	39	42	39	43	39	44	39	45	38	46	38	47	38	48	38	50	50	51	52	53	54	55	56	57	58	59
4	0	42	2	43	2	44	2	45	1	46	1	47	1	48	1	49	1	0	0	1	2	3	4	5	6	7	8	9
	10	42	24	43	23	44	23	45	23	46	23	47	23	48	23	49	22	10	10	11	12	13	14	15	16	17	18	19
	20	42	44	43	44	44	44	45	43	46	42	47	43	48	43	49	43	20	20	21	22	23	24	25	26	27	28	29
	30	43	3	44	3	45	3	46	3	47	2	48	2	49	2	50	2	30	30	31	32	33	34	35	36	37	38	39
	40	43	21	44	21	45	21	46	21	47	21	48	20	49	20	50	20	40	40	41	42	43	44	45	46	47	48	49
	50	43	39	44	38	45	38	46	38	47	38	48	37	49	37	50	37	50	50	51	52	53	54	55	56	57	58	59
5	0	43	55	44	54	45	54	46	54	47	54	48	54	49	53	50	53	0	0	1	2	3	4	5	6	7	8	9
	10	44	10	45	10	46	10	47	9	48	9	49	9	50	9	51	8	10	10	11	12	13	14	15	16	17	18	19
	20	44	25	45	24	46	24	47	24	48	24	49	23	50	23	51	23	20	20	21	22	23	24	25	26	27	28	29
	30	44	38	45	38	46	38	47	38	48	37	49	37	50	37	51	36	30	30	31	32	33	34	35	36	37	38	39
	40	44	51	45	51	46	51	47	51	48	50	49	50	50	50	51	49	40	40	41	42	43	44	45	46	47	48	49
	50	45	4	46	3	47	3	48	3	49	3	50	2	51	2	52	2	50	50	51	52	53	54	55	56	57	58	59
6	0	45	16	46	15	47	15	48	15	49	14	50	14	51	14	52	13	0	0	1	2	3	4	5	6	7	8	9
	10	45	27	46	26	47	26	48	26	49	25	50	25	51	25	52	24	10	10	11	12	13	14	15	16	17	18	19
	20	45	37	46	37	47	37	48	36	49	36	50	35	51	35	52	35	20	20	21	22	23	24	25	26	27	28	29
	30	45	47	46	47	47	47	48	46	49	46	50	45	51	45	52	45	30	30	31	32	33	34	35	36	37	38	39
	40	45	57	46	57	47	56	48	56	49	55	50	55	51	55	52	54	40	40	41	42	43	44	45	46	47	48	49
	50	46	6	47	6	48	5	49	5	50	4	51	4	52	4	53	3	50	50	51	52	53	54	55	56	57	58	59
7	0	46	15	47	14	48	14	49	13	50	13	51	13	52	12	53	12	0	0	1	2	3	4	5	6	7	8	9
	10	46	23	47	23	48	22	49	22	50	21	51	21	52	20	53	20	10	10	11	12	13	14	15	16	17	18	19
	20	46	31	47	30	48	30	49	29	50	29	51	28	52	28	53	27	20	20	21	22	23	24	25	26	27	28	29
	30	46	38	47	38	48	37	49	37	50	36	51	36	52	35	53	35	30	30	31	32	33	34	35	36	37	38	39
	40	46	45	47	45	48	44	49	44	50	43	51	43	52	42	53	42	40	40	41	42	43	44	45	46	47	48	49
	50	46	52	47	52	48	51	49	51	50	50	51	49	52	49	53	48	50	50	51	52	53	54	55	56	57	58	59
8	0	46	59	47	58	48	58	49	57	50	56	51	56	52	55	53	55	0	0	1	2	3	4	5	6	7	8	9
	10	47	5	48	4	49	4	50	3	51	2	52	2	53	1	54	1	10	10	11	12	13	14	15	16	17	18	19
	20	47	11	48	10	49	9	50	9	51	8	52	8	53	7	54	6	20	20	21	22	23	24	25	26	27	28	29
	30	47	16	48	16	49	15	50	14	51	14	52	13	53	12	54	12	30	30	31	32	33	34	35	36	37	38	39
	40	47	22	48	21	49	20	50	20	51	19	52	18	53	17	54	17	40	40	41	42	43	44	45	45	46	47	48
	50	47	27	48	26	49	25	50	25	51	24	52	23	53	22	54	22	50	49	50	51	52	53	54	55	56	57	58
9	0	47	31	48	31	49	30	50	29	51	29	52	28	53	27	54	26	0	0	1	2	3	4	5	6	7	8	9
	10	47	36	48	35	49	35	50	34	51	33	52	32	53	31	54	31	10	10	11	12	13	14	15	16	17	18	19
	20	47	40	48	40	49	39	50	38	51	37	52	36	53	36	54	35	20	20	21	22	23	24	25	26	27	28	29
	30	47	45	48	44	49	43	50	42	51	41	52	40	53	40	54	39	30	30	31	32	33	34	35	36	36	37	38
	40	47	48	48	47	49	47	50	46	51	45	52	44	53	43	54	43	40	39	40	41	42	43	44	45	46	47	48
	50	47	52	48	51	49	50	50	50	51	49	52	48	53	47	54	46	50	49	50	51	52	53	54	55	56	57	58

Proportional parts to Minutes of Altitude—Add

☽ alt.		1′	2′	3′	4′	5′	6′	7′	8′	9′	☽ alt.		1′	2′	3′	4′	5′	6′	7′	8′	9′
3°	0′	3″	6″	9″	13″	16″	19″	22″	25″	28″	6°	0′	1″	2″	3″	4″	5″	7″	8″	9″	10″
	10	3	6	9	12	15	18	21	24	27		10	1	2	3	4	5	6	7	8	10
	20	2	5	8	11	14	17	19	22	25		20	1	2	3	4	5	6	7	8	9
	30	2	5	8	10	13	16	18	21	23		30	1	2	3	4	5	6	7	8	9
	40	2	5	7	10	12	15	17	19	22		40	1	2	3	4	5	5	6	7	8
	50	2	5	7	9	11	14	16	18	21		50	1	2	3	3	4	5	6	7	8
4	0	2	4	7	9	11	13	15	17	19	7	0	1	2	2	3	4	5	6	7	7
	10	2	4	6	8	10	12	14	16	18		10	1	2	2	3	4	5	5	6	7
	20	2	4	6	8	10	11	13	15	17		20	1	1	2	3	4	4	5	6	7
	30	2	4	5	7	9	11	13	14	16		30	1	1	2	3	3	4	5	6	6
	40	2	3	5	7	9	10	12	14	15		40	1	1	2	3	3	4	5	5	6
	50	2	3	5	6	8	10	11	13	14		50	1	1	2	3	3	4	5	5	6
5	0	2	3	5	6	8	9	11	12	14	8	0	1	1	2	2	3	3	4	5	5
	10	2	3	4	6	7	9	10	12	13	or	10	1	1	2	2	3	3	4	4	5
	20	1	3	4	5	7	8	10	11	12	9	20	0	1	1	2	2	3	3	4	4
	30	1	3	4	5	6	8	9	10	12		30	0	1	1	2	2	2	3	4	4
	40	1	2	4	5	6	7	9	10	11		40	0	1	1	2	2	2	3	3	4
	50	1	2	4	5	6	7	8	9	11		50	0	1	1	2	2	2	3	3	3

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽ App altit.		Horizontal Parallax.																Prop. parts for Seconds of Par.										
		54′		55′		56′		57′		58′		59′		60′		61′			0′	1″	2″	3″	4″	5″	6″	7″	8″	9″
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″	″	″	″	″	″
10	0	47	56	48	55	49	54	50	53	51	52	52	51	53	50	54	49	0	0	1	2	3	4	5	6	7	8	9
	10	47	59	48	58	49	57	50	56	51	55	52	54	53	53	54	52	10	10	11	12	13	14	15	16	17	18	19
	20	48	2	49	1	50	0	50	59	51	58	52	57	53	56	54	56	20	20	21	22	23	24	25	26	27	28	29
	30	48	5	49	4	50	3	51	2	52	1	53	0	53	59	54	58	30	29	30	31	32	33	34	35	36	37	38
	40	48	8	49	7	50	6	51	5	52	4	53	3	54	2	55	1	40	39	40	41	42	43	44	45	46	47	48
	50	48	11	49	10	50	9	51	8	52	7	53	6	54	4	55	3	50	49	50	51	52	53	54	55	56	57	58
11	0	48	13	49	12	50	11	51	10	52	9	53	8	54	7	55	6	0	0	1	2	3	4	5	6	7	8	9
	10	48	16	49	15	50	14	51	12	52	11	53	10	54	9	55	8	10	10	11	12	13	14	15	16	17	18	19
	20	48	18	49	17	50	16	51	15	52	13	53	12	54	11	55	10	20	20	21	22	23	24	24	25	26	27	28
	30	48	20	49	19	50	18	51	17	52	15	53	14	54	13	55	12	30	29	30	31	32	33	34	35	36	37	38
	40	48	22	49	21	50	20	51	19	52	17	53	16	54	15	55	14	40	39	40	41	42	43	44	45	46	47	48
	50	48	24	49	23	50	22	51	20	52	19	53	18	54	16	55	15	50	49	50	51	52	53	54	55	56	57	58
12	0	48	26	49	25	50	23	51	22	52	21	53	19	54	18	55	17	0	0	1	2	3	4	5	6	7	8	9
	10	48	27	49	26	50	25	51	23	52	22	53	21	54	19	55	18	10	10	11	12	13	14	15	16	17	18	19
	20	48	29	49	28	50	26	51	25	52	23	53	22	54	21	55	19	20	20	21	21	22	23	24	25	26	27	28
	30	48	30	49	29	50	27	51	26	52	25	53	23	54	22	55	20	30	29	30	31	32	33	34	35	36	37	38
	40	48	32	49	30	50	29	51	27	52	26	53	24	54	23	55	21	40	39	40	41	42	43	44	45	46	47	48
	50	48	33	49	31	50	30	51	28	52	27	53	25	54	24	55	22	50	49	50	51	52	53	54	55	56	57	58
13	0	48	34	49	32	50	31	51	29	52	28	53	26	54	25	55	23	0	0	1	2	3	4	5	6	7	8	9
	10	48	35	49	33	50	32	51	30	52	28	53	27	54	25	55	24	10	10	11	12	13	14	15	16	17	18	18
	20	48	36	49	34	50	32	51	31	52	29	53	28	54	26	55	24	20	19	20	21	22	23	24	25	26	27	28
	30	48	36	49	35	50	33	51	31	52	30	53	28	54	26	55	25	30	29	30	31	32	33	34	35	36	37	38
	40	48	37	49	35	50	34	51	32	52	30	53	29	54	27	55	25	40	39	40	41	42	43	44	45	46	47	48
	50	48	38	49	36	50	34	51	32	52	31	53	29	54	27	55	25	50	49	50	51	52	53	53	54	55	56	57
14	0	48	38	49	36	50	35	51	33	52	31	53	29	54	27	55	26	0	0	1	2	3	4	5	6	7	8	9
	10	48	39	49	37	50	35	51	33	52	31	53	29	54	28	55	26	10	10	11	12	13	14	15	15	16	17	18
	20	48	39	49	37	50	35	51	33	52	31	53	30	54	28	55	26	20	19	20	21	22	23	24	25	26	27	28
	30	48	39	49	37	50	35	51	33	52	31	53	30	54	28	55	26	30	29	30	31	32	33	34	35	36	37	38
	40	48	39	49	37	50	35	51	33	52	31	53	30	54	28	55	26	40	39	40	41	42	43	44	45	46	46	47
	50	48	39	49	37	50	35	51	33	52	31	53	29	54	27	55	25	50	48	49	50	51	52	53	54	55	56	57
15	0	48	39	49	37	50	35	51	33	52	31	53	29	54	27	55	25	0	0	1	2	3	4	5	6	7	8	9
	10	48	39	49	37	50	35	51	33	52	31	53	29	54	27	55	25	10	10	11	12	13	14	14	15	16	17	18
	20	48	39	49	37	50	35	51	33	52	31	53	28	54	26	55	24	20	19	20	21	22	23	24	25	26	27	28
	30	48	39	49	37	50	34	51	32	52	30	53	28	54	26	55	24	30	29	30	31	32	33	34	35	36	37	38
	40	48	39	49	36	50	34	51	32	52	30	53	27	54	25	55	23	40	39	39	40	41	42	43	44	45	46	47
	50	48	38	49	36	50	34	51	31	52	29	53	27	54	24	55	22	50	48	49	50	51	52	53	54	55	56	57
16	0	48	38	49	35	50	33	51	31	52	28	53	26	54	24	55	21	0	0	1	2	3	4	5	6	7	8	9
	10	48	37	49	35	50	32	51	30	52	28	53	25	54	23	55	21	10	10	11	12	13	14	15	15	16	17	18
	20	48	37	49	34	50	32	51	29	52	27	53	25	54	22	55	20	20	19	20	21	22	23	24	25	26	27	28
	30	48	36	49	33	50	31	51	29	52	26	53	24	54	21	55	19	30	29	30	31	32	33	34	35	36	37	38
	40	48	35	49	33	50	30	51	28	52	25	53	23	54	20	55	18	40	39	39	40	41	42	43	44	45	46	47
	50	48	34	49	32	50	29	51	27	52	24	53	22	54	19	55	16	50	48	49	50	51	52	53	54	55	56	57
17	0	48	34	49	31	50	28	51	26	52	23	53	21	54	18	55	15	0	0	1	2	3	4	5	6	7	8	9
	10	48	33	49	30	50	27	51	25	52	22	53	19	54	17	55	14	10	10	10	11	12	13	14	15	16	17	18
	20	48	32	49	29	50	26	51	24	52	21	53	18	54	15	55	13	20	19	20	21	22	23	24	25	26	27	28
	30	48	31	49	28	50	25	51	22	52	20	53	17	54	14	55	11	30	29	30	30	31	32	33	34	35	36	37
	40	48	30	49	27	50	24	51	21	52	18	53	16	54	13	55	10	40	38	39	40	41	42	43	44	45	46	47
	50	48	29	49	26	50	23	51	20	52	17	53	14	54	11	55	8	50	48	49	50	51	52	52	53	54	55	56
18	0	48	27	49	24	50	22	51	19	52	16	53	13	54	10	55	7	0	0	1	2	3	4	5	6	7	8	9
	10	48	26	49	23	50	20	51	17	52	14	53	11	54	8	55	5	10	9	10	11	12	13	14	15	16	17	18
	20	48	25	49	22	50	19	51	16	52	13	53	10	54	7	55	4	20	19	20	21	22	23	24	25	26	27	27
	30	48	23	49	20	50	17	51	14	52	11	53	8	54	5	55	2	30	28	29	30	31	32	33	34	35	36	37
	40	48	22	49	19	50	16	51	13	52	9	53	6	54	3	55	0	40	38	39	40	41	42	43	44	45	46	46
	50	48	21	49	17	50	14	51	11	52	8	53	5	54	1	54	58	50	47	48	49	50	51	52	53	54	55	56
19	0	48	19	49	16	50	13	51	9	52	6	53	3	54	0	54	56	0	0	1	2	3	4	5	6	7	8	8
	10	48	18	49	14	50	11	51	8	52	4	53	1	53	58	54	54	10	9	10	11	12	13	14	15	16	17	18
	20	48	16	49	13	50	9	51	6	52	2	52	59	53	56	54	52	20	19	20	21	22	23	24	24	25	26	27
	30	48	14	49	11	50	7	51	4	52	1	52	57	53	54	54	50	30	28	29	30	31	32	33	34	35	36	37
	40	48	13	49	9	50	6	51	2	51	59	52	55	53	52	54	48	40	38	39	40	41	41	42	43	44	45	46
	50	48	11	49	7	50	4	51	0	51	57	52	53	53	49	54	46	50	47	48	49	50	51	52	53	54	55	56

P. parts to min. of alt.	1′	2′	3′	4′	5′	6′	7′	8′	9′	Add.
	0″	0″	0″	0″	1″	1″	1″	1″	1″	

P. parts to min. of alt.	1′	2′	3′	4′	5′	6′	7′	8′	9′	Sub.
	0″	0″	0″	0″	1″	1″	1″	1″	1″	

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽ App altit.		Horizontal Parallax. 54′		55′		56′		57′		58′		59′		60′		61′		Prop. parts for seconds of Par.	0″	1″	2″	3″	4″	5″	6″	7″	8″	9″
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″	″	″	″	″	″
20	0	48	9	49	5	50	2	50	58	51	55	52	51	53	47	54	44	0	0	1	2	3	4	5	6	7	8	8
	10	48	7	49	3	50	0	50	56	51	52	52	49	53	45	54	41	10	9	10	11	12	13	14	15	16	17	18
	20	48	5	49	1	49	58	50	54	51	50	52	46	53	43	54	39	20	19	20	21	22	22	23	24	25	26	27
	30	48	3	48	59	49	56	50	52	51	48	52	44	53	40	54	37	30	28	29	30	31	32	33	34	35	36	37
	40	48	1	48	57	49	53	50	50	51	46	52	42	53	38	54	34	40	37	38	39	40	41	42	43	44	45	46
	50	47	59	48	55	49	51	50	47	51	44	52	40	53	36	54	32	50	47	48	49	50	51	51	52	53	54	55
21	0	47	57	48	53	49	49	50	45	51	41	52	37	53	33	54	29	0	0	1	2	3	4	5	6	7	7	8
	10	47	55	48	51	49	47	50	43	51	39	52	35	53	31	54	27	10	9	10	11	12	13	14	15	16	17	18
	20	47	53	48	49	49	45	50	40	51	36	52	32	53	28	54	24	20	19	20	21	21	22	23	24	25	26	27
	30	47	51	48	46	49	42	50	38	51	34	52	30	53	26	54	21	30	28	29	30	31	31	32	33	34	35	36
	40	47	48	48	44	49	40	50	36	51	31	52	27	53	23	54	19	40	37	38	39	40	41	42	43	44	45	46
	50	47	46	48	42	49	37	50	33	51	29	52	25	53	20	54	16	50	47	47	48	49	50	51	52	53	54	55
22	0	47	44	48	39	49	35	50	31	51	26	52	22	53	18	54	13	0	0	1	2	3	4	5	6	6	7	8
	10	47	41	48	37	49	32	50	28	51	24	52	19	53	15	54	10	10	9	10	11	12	13	14	15	16	17	18
	20	47	39	48	34	49	30	50	25	51	21	52	16	53	12	54	7	20	18	19	20	21	22	23	24	25	26	27
	30	47	36	48	32	49	27	50	23	51	18	52	14	53	9	54	4	30	28	29	30	30	31	32	33	34	35	36
	40	47	34	48	29	49	25	50	20	51	15	52	11	53	6	54	1	40	37	38	39	40	41	42	43	43	44	45
	50	47	31	48	27	49	22	50	17	51	13	52	8	53	3	53	58	50	46	47	48	49	50	51	52	53	54	55
23	0	47	29	48	24	49	19	50	14	51	10	52	5	53	0	53	55	0	0	1	2	3	4	5	6	6	7	8
	10	47	26	48	21	49	16	50	12	51	7	52	2	52	57	53	52	10	9	10	11	12	13	14	15	16	17	17
	20	47	23	48	19	49	14	50	9	51	4	51	59	52	54	53	49	20	18	19	20	21	22	23	24	25	26	27
	30	47	21	48	16	49	11	50	6	51	1	51	56	52	51	53	46	30	28	28	29	30	31	32	33	34	35	36
	40	47	18	48	13	49	8	50	3	50	58	51	53	52	48	53	43	40	37	38	39	39	40	41	42	43	44	45
	50	47	15	48	10	49	5	50	0	50	55	51	50	52	44	53	39	50	46	47	48	49	50	50	51	52	53	54
24	0	47	12	48	7	49	2	49	57	50	52	51	47	52	41	53	36	0	0	1	2	3	4	5	5	6	7	8
	10	47	10	48	4	48	59	49	54	50	48	51	43	52	38	53	33	10	9	10	11	12	13	14	15	15	16	17
	20	47	7	48	1	48	56	49	51	50	45	51	40	52	35	53	29	20	18	19	20	21	22	23	24	25	25	26
	30	47	4	47	58	48	53	49	47	50	42	51	37	52	31	53	26	30	27	28	29	30	31	32	33	34	35	35
	40	47	1	47	55	48	50	49	44	50	39	51	33	52	28	53	22	40	36	37	38	39	40	41	42	43	44	45
	50	46	58	47	52	48	47	49	41	50	35	51	30	52	24	53	19	50	46	46	47	48	49	50	51	52	53	54
25	0	46	55	47	49	48	43	49	38	50	32	51	27	52	21	53	15	0	0	1	2	3	4	5	5	6	7	8
	10	46	52	47	46	48	40	49	34	50	29	51	23	52	17	53	12	10	9	10	11	12	13	14	14	15	16	17
	20	46	48	47	43	48	37	49	31	50	25	51	20	52	14	53	8	20	18	19	20	21	22	23	23	24	25	26
	30	46	45	47	39	48	34	49	28	50	22	51	16	52	10	53	4	30	27	28	29	30	31	32	32	33	34	35
	40	46	42	47	36	48	30	49	24	50	18	51	13	52	7	53	1	40	36	37	38	39	40	41	41	42	43	44
	50	46	39	47	33	48	27	49	21	50	15	51	9	52	3	52	57	50	45	46	47	48	49	50	51	51	52	53
26	0	46	36	47	30	48	23	49	17	50	11	51	5	51	59	52	53	0	0	1	2	3	4	4	5	6	7	8
	10	46	32	47	26	48	20	49	14	50	8	51	2	51	55	52	49	10	9	10	11	12	13	13	14	15	16	17
	20	46	29	47	23	48	17	49	10	50	4	50	58	51	52	52	45	20	18	19	20	21	21	22	23	24	25	26
	30	46	26	47	19	48	13	49	7	50	0	50	54	51	48	52	41	30	27	28	29	30	30	31	32	33	34	35
	40	46	22	47	16	48	9	49	3	49	57	50	50	51	44	52	37	40	36	37	38	39	40	40	41	42	43	44
	50	46	19	47	12	48	6	48	59	49	53	50	46	51	40	52	34	50	45	46	47	47	48	49	50	51	52	53
27	0	46	15	47	9	48	2	48	56	49	49	50	43	51	36	52	30	0	0	1	2	3	4	4	5	6	7	8
	10	46	12	47	5	47	59	48	52	49	45	50	39	51	32	52	26	10	9	10	11	12	12	13	14	15	16	17
	20	46	8	47	2	47	55	48	48	49	42	50	35	51	28	52	21	20	18	19	20	20	21	22	23	24	25	26
	30	46	5	46	58	47	51	48	44	49	39	50	31	51	24	52	17	30	27	27	28	29	30	31	32	33	34	35
	40	46	1	46	54	47	47	48	40	49	34	50	27	51	20	52	13	40	35	36	37	38	39	40	41	42	43	43
	50	45	58	46	51	47	44	48	37	49	30	50	23	51	16	52	9	50	44	45	46	47	48	49	50	51	51	52
28	0	45	54	46	47	47	40	48	33	49	26	50	19	51	12	52	5	0	0	1	2	3	4	4	5	6	7	8
	10	45	50	46	43	47	36	48	29	49	22	50	15	51	8	52	0	10	9	10	11	11	12	13	14	15	16	17
	20	45	46	46	39	47	32	48	25	49	17	50	10	51	4	51	56	20	18	18	19	20	21	22	23	24	25	25
	30	45	43	46	35	47	28	48	21	49	14	50	6	50	59	51	52	30	26	27	28	29	30	31	32	32	33	34
	40	45	39	46	32	47	24	48	17	49	9	50	2	50	55	51	47	40	35	36	37	38	39	40	40	41	42	43
	50	45	35	46	28	47	20	48	13	49	5	49	58	50	50	51	43	50	44	45	46	47	47	48	49	50	51	52
29	0	45	31	46	24	47	16	48	9	49	1	49	54	50	46	51	39	0	0	1	2	3	3	4	5	6	7	8
	10	45	27	46	20	47	12	48	5	48	57	49	49	50	42	51	34	10	9	10	10	11	12	13	14	15	16	17
	20	45	23	46	16	47	8	48	0	48	53	49	45	50	37	51	30	20	17	18	19	20	21	22	23	23	24	25
	30	45	19	46	12	47	4	47	56	48	48	49	41	50	33	51	25	30	26	27	28	29	30	30	31	32	33	34
	40	45	15	46	8	47	0	47	52	48	44	49	36	50	28	51	20	40	35	36	37	37	38	39	40	41	42	43
	50	45	12	46	4	46	56	47	48	48	40	49	32	50	24	51	16	50	44	44	45	46	47	48	49	50	50	51

Prop. parts to min. of altit.	1′	2′	3′	4′	5′	6′	7′	8′	9′	
	0″	1″	1″	1″	2″	2″	2″	3″	3″	Sub.

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽ App altit.		Horizontal Parallax.																Prop. parts for Seconds of Par.										
		54′		55′		56′		57′		58′		59′		60′		61′			0″	1″	2″	3″	4″	5″	6″	7″	8″	9″
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″	″	″	″	″	″
30	0	45	7	45	59	46	51	47	43	48	35	49	27	50	19	51	11	0	0	1	2	3	3	4	5	6	7	8
	10	45	3	45	55	46	47	47	39	48	31	49	23	50	15	51	7	10	9	9	10	11	12	13	14	15	16	16
	20	44	59	45	51	46	43	47	35	48	26	49	18	50	10	51	2	20	17	18	19	20	21	22	22	23	24	25
	30	44	55	45	47	46	39	47	30	48	22	49	14	50	5	50	57	30	26	27	28	28	29	30	31	32	33	34
	40	44	51	45	43	46	34	47	26	48	17	49	9	50	1	50	52	40	34	35	36	37	38	39	40	41	41	42
	50	44	47	45	38	46	30	47	21	48	13	49	4	49	56	50	47	50	43	44	45	46	47	47	48	49	50	51
31	0	44	43	45	34	46	25	47	17	48	8	49	0	49	51	50	43	0	0	1	2	3	3	4	5	6	7	8
	10	44	38	45	30	46	21	47	12	48	4	48	55	49	46	50	38	10	9	9	10	11	12	13	14	15	15	16
	20	44	34	45	25	46	17	47	8	47	59	48	50	49	42	50	33	20	17	18	19	20	20	21	22	23	24	25
	30	44	30	45	21	46	12	47	3	47	54	48	46	49	37	50	28	30	26	26	27	28	29	30	31	32	32	33
	40	44	25	45	16	46	8	46	59	47	50	48	41	49	32	50	23	40	34	35	36	37	38	38	39	40	41	42
	50	44	21	45	12	46	3	46	54	47	45	48	36	49	27	50	18	50	43	44	44	45	46	47	48	49	49	50
32	0	44	17	45	8	45	58	46	49	47	40	48	31	49	22	50	13	0	0	1	2	3	3	4	5	6	7	8
	10	44	12	45	3	45	54	46	45	47	35	48	26	49	17	50	8	10	8	9	10	11	12	13	13	14	15	16
	20	44	8	44	58	45	49	46	40	47	31	48	21	49	12	50	3	20	17	18	19	19	20	21	22	23	24	24
	30	44	3	44	54	45	45	46	35	47	26	48	16	49	7	49	58	30	25	26	27	28	28	29	30	31	32	33
	40	43	59	44	49	45	40	46	30	47	21	48	11	49	2	49	52	40	33	34	35	36	37	38	38	39	40	41
	50	43	54	44	45	45	35	46	26	47	16	48	6	48	57	49	47	50	42	43	44	45	46	47	47	48	49	50
33	0	43	50	44	40	45	30	46	21	47	11	48	1	48	52	49	42	0	0	1	2	3	3	4	5	6	7	8
	10	43	45	44	35	45	26	46	16	47	6	47	56	48	46	49	37	10	8	9	10	11	12	13	13	14	15	16
	20	43	40	44	31	45	21	46	11	47	1	47	51	48	41	49	31	20	17	18	18	19	20	21	22	23	23	24
	30	43	36	44	26	45	16	46	6	46	56	47	46	48	36	49	26	30	25	26	27	28	28	29	30	31	32	33
	40	43	31	44	21	45	11	46	1	46	51	47	41	48	31	49	21	40	33	34	35	36	37	38	38	39	40	41
	50	43	26	44	16	45	6	45	56	46	46	47	36	48	26	49	15	50	42	43	43	44	45	46	47	48	48	49
34	0	43	22	44	12	45	1	45	51	46	41	47	30	48	20	49	10	0	0	1	2	2	3	4	5	6	7	7
	10	43	17	44	7	44	56	45	46	46	36	47	25	48	15	49	5	10	8	9	10	11	12	12	13	14	15	16
	20	43	12	44	2	44	51	45	41	46	30	47	20	48	9	48	59	20	16	17	18	19	20	21	21	22	23	24
	30	43	7	43	57	44	46	45	36	46	25	47	15	48	4	48	54	30	25	26	26	27	28	29	30	30	31	32
	40	43	3	43	52	44	41	45	31	46	20	47	9	47	59	48	48	40	33	34	35	35	36	37	38	39	40	40
	50	42	58	43	47	44	36	45	25	46	15	47	4	47	53	48	42	50	41	42	43	44	44	45	46	47	48	49
35	0	42	53	43	42	44	31	45	20	46	9	46	59	47	48	48	37	0	0	1	2	2	3	4	5	6	7	7
	10	42	48	43	37	44	26	45	15	46	4	46	53	47	42	48	31	10	8	9	10	11	11	12	13	14	15	15
	20	42	43	43	32	44	21	45	10	45	59	46	48	47	37	48	26	20	16	17	18	19	20	20	21	22	23	24
	30	42	38	43	27	44	16	45	5	45	53	46	42	47	31	48	20	30	24	25	26	27	28	28	29	30	31	32
	40	42	33	43	22	44	10	44	59	45	48	46	37	47	24	48	14	40	33	33	34	35	36	37	37	38	39	40
	50	42	28	43	17	44	5	44	54	45	43	46	31	47	20	48	8	50	41	42	42	43	44	45	46	46	47	48
36	0	42	23	43	11	44	0	44	49	45	37	46	26	47	14	48	3	0	0	1	2	2	3	4	5	6	6	7
	10	42	18	43	6	43	55	44	43	45	32	46	20	47	8	47	57	10	8	9	10	10	11	12	13	14	14	15
	20	42	13	43	1	43	49	44	38	45	26	46	14	47	3	47	51	20	16	17	18	18	19	20	21	22	23	[illegible]
	30	42	8	42	56	43	44	44	32	45	21	46	9	46	57	47	45	30	24	25	26	27	27	28	29	30	31	31
	40	42	2	42	51	43	39	44	27	45	15	46	3	46	51	47	39	40	32	33	34	35	35	36	37	38	39	39
	50	41	57	42	45	43	33	44	21	45	9	45	57	46	45	47	33	50	40	41	42	43	43	44	45	46	47	47
37	0	41	52	42	40	43	28	44	16	45	3	45	52	46	40	47	28	0	0	1	2	2	3	4	5	6	6	7
	10	41	47	42	35	43	22	44	10	44	58	45	46	46	34	47	22	10	8	9	10	10	11	12	13	13	14	15
	20	41	42	42	29	43	17	44	5	44	52	45	40	46	28	47	16	20	16	17	17	18	19	20	21	21	22	23
	30	41	36	42	24	43	11	43	59	44	47	45	34	46	22	47	9	30	24	25	25	26	27	28	29	29	30	31
	40	41	31	42	18	43	6	43	53	44	41	45	28	46	16	47	3	40	32	33	33	34	35	36	36	37	38	39
	50	41	26	42	13	43	0	43	48	44	35	45	[illegible]	[illegible]	10	46	57	50	40	40	41	42	43	44	44	45	46	47
38	0	41	20	42	8	42	55	43	42	44	29	45	17	46	4	46	51	0	0	1	2	2	3	4	5	5	6	7
	10	41	15	42	2	42	49	43	36	44	24	45	11	45	58	46	45	10	8	9	9	10	11	12	12	13	14	15
	20	41	10	41	57	42	44	43	31	44	18	45	5	45	52	46	39	20	16	16	17	18	19	20	20	21	22	23
	30	41	4	41	51	42	38	43	25	44	12	44	59	45	46	46	33	30	23	24	25	26	27	27	28	29	30	31
	40	40	59	41	45	42	32	43	19	44	6	44	53	45	40	46	27	40	31	32	33	34	34	35	36	37	38	38
	50	40	53	41	40	42	27	43	13	44	0	44	47	45	34	46	20	50	39	40	41	41	42	43	44	45	45	46
39	0	40	48	41	34	42	21	43	8	43	54	44	41	45	27	46	14	0	0	1	2	2	3	4	5	5	6	7
	10	40	41	41	29	42	15	43	2	43	48	44	35	45	21	46	8	10	8	9	9	10	11	12	12	13	14	15
	20	40	37	41	23	42	9	42	56	43	42	44	29	45	15	46	1	20	15	16	17	18	19	19	20	21	22	23
	30	40	31	41	17	42	4	42	50	43	36	44	22	45	9	45	55	30	23	24	25	25	26	27	28	29	29	30
	40	40	25	41	12	41	58	42	44	43	30	44	16	45	3	45	49	40	31	32	32	33	34	35	36	36	37	38
	50	40	20	41	6	41	52	42	38	43	24	44	10	44	56	45	42	50	39	39	40	41	42	42	43	44	45	46

Prop. parts to min. of altit.	1′	2′	3′	4′	5′	6′	7′	8′	9′	Sub.
	1″	1″	2″	2″	3″	3″	4″	4″	5″	

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽ App. altit.	Horizontal Parallax.								Prop. parts for Seconds of Par.										
	54′	55′	56′	57′	58′	59′	60′	61′		0″	1″	2″	3″	4″	5″	6″	7″	8″	9″
° ′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	″	″	″	″	″	″	″	″	″	″
40 0	40 14	41 0	41 46	42 32	43 18	44 4	44 50	45 36	0	0	1	1	2	3	4	5	5	6	7
10	40 8	40 54	41 40	42 26	43 12	43 58	44 44	45 29	10	8	8	9	10	11	11	12	13	14	14
20	40 3	40 49	41 34	42 20	43 6	43 51	44 37	45 22	20	15	16	17	17	18	19	20	21	21	22
30	39 57	40 43	41 28	42 14	43 0	43 45	44 31	45 16	30	23	24	24	25	26	27	27	28	29	30
40	39 51	40 37	41 22	42 8	42 53	43 39	44 24	45 10	40	30	31	32	33	33	34	35	36	36	37
50	39 46	40 31	41 16	42 2	42 47	43 33	44 18	45 3	50	38	39	40	40	41	42	43	43	44	45
41 0	39 40	40 25	41 10	41 56	42 41	43 26	44 11	44 57	0	0	1	1	2	3	4	4	5	6	7
10	39 34	40 19	41 4	41 49	42 35	43 20	44 5	44 50	10	7	8	9	10	10	11	12	13	13	4
20	39 28	40 13	40 58	41 43	42 28	43 13	43 58	44 43	20	15	16	16	17	18	19	19	20	21	22
30	39 22	40 7	40 52	41 37	42 22	43 7	43 52	44 37	30	22	23	24	25	25	26	27	28	28	29
40	39 16	40 1	40 46	41 31	42 16	43 1	43 45	44 30	40	30	31	31	32	33	34	34	35	36	37
50	39 10	39 55	40 40	41 25	42 9	42 54	43 39	44 23	50	37	38	39	40	40	41	42	43	43	44
42 0	39 5	39 49	40 34	41 18	42 3	42 47	43 32	44 17	0	0	1	1	2	3	4	4	5	6	7
10	38 59	39 43	40 28	41 12	41 57	42 41	43 25	44 10	10	7	8	9	10	10	11	12	13	13	14
20	38 53	39 37	40 21	41 6	41 50	42 34	43 19	44 3	20	15	15	16	17	18	18	19	20	21	21
30	38 47	39 31	40 15	40 59	41 44	42 28	43 12	43 56	30	22	23	24	24	25	26	27	27	28	29
40	38 41	39 25	40 9	40 53	41 37	42 21	43 5	43 49	40	29	30	31	32	32	33	34	35	35	36
50	38 35	39 19	40 3	40 47	41 31	42 15	42 59	43 43	50	37	38	38	39	40	41	41	42	43	43
43 0	38 29	39 12	39 56	40 40	41 24	42 8	42 52	43 36	0	0	1	1	2	3	4	4	5	6	7
10	38 22	39 6	39 50	40 34	41 18	42 1	42 45	43 29	10	7	8	9	9	10	11	12	12	13	14
20	38 16	39 0	39 44	40 27	41 11	41 55	42 38	43 22	20	15	15	16	17	17	18	19	20	20	21
30	38 10	38 54	39 37	40 21	41 4	41 48	42 31	43 15	30	22	22	23	24	25	25	26	27	28	28
40	38 4	38 47	39 31	40 14	40 58	41 41	42 24	43 8	40	29	30	30	31	32	33	33	34	35	36
50	37 58	38 41	39 24	40 8	40 51	41 34	42 18	43 1	50	36	37	38	38	39	40	41	11	42	43
44 0	37 52	38 35	39 18	40 1	40 44	41 28	42 11	42 54	0	0	1	1	2	3	4	4	5	6	6
10	37 46	38 29	39 12	39 55	40 38	41 21	42 4	42 47	10	7	8	9	9	10	11	11	12	13	14
20	37 39	38 22	39 5	39 48	40 31	41 14	41 57	42 40	20	14	15	16	16	17	18	19	19	20	21
30	37 33	38 16	38 59	39 41	40 24	41 7	41 50	42 33	30	21	22	23	24	24	25	26	26	27	28
40	37 27	38 9	38 52	39 35	40 17	41 0	41 43	42 25	40	29	29	30	31	31	32	33	34	34	35
50	37 20	38 3	38 46	39 28	40 11	40 53	41 36	42 18	50	36	36	37	38	39	39	40	41	41	42
45 0	37 14	37 57	38 39	39 21	40 4	40 46	41 29	42 11	0	0	1	1	2	3	4	4	5	6	6
10	37 8	37 50	38 32	39 15	39 57	40 39	41 22	42 4	10	7	8	8	9	10	11	11	12	13	13
20	37 1	37 43	38 26	39 8	39 50	40 32	41 14	41 57	20	14	15	15	16	17	18	18	19	20	20
30	36 55	37 37	38 19	39 1	39 43	40 25	41 7	41 49	30	21	22	22	23	24	25	25	26	27	27
40	36 49	37 31	38 12	38 54	39 36	40 18	41 0	41 42	40	28	29	29	30	31	32	32	33	34	34
50	36 42	37 24	38 6	38 48	39 29	40 11	40 53	41 35	50	35	36	36	37	38	39	39	40	41	41
46 0	36 36	37 17	37 59	38 41	39 22	40 4	40 46	41 27	0	0	1	1	2	3	4	4	5	6	6
10	36 29	37 11	37 52	38 34	39 15	39 57	40 39	41 20	10	7	8	8	9	10	10	11	12	12	13
20	36 23	37 4	37 46	38 27	39 8	39 50	40 31	41 13	20	14	14	15	16	17	17	18	19	19	20
30	36 16	36 58	37 39	38 20	39 1	39 43	40 24	41 5	30	21	21	22	23	23	24	25	25	26	27
40	36 10	36 51	37 32	38 13	38 54	39 36	40 17	40 58	40	28	28	29	30	30	31	32	32	33	34
50	36 3	36 44	37 25	38 6	38 47	39 28	40 9	40 50	50	34	35	36	36	37	38	39	39	40	41
47 0	35 57	36 38	37 18	37 59	38 40	39 21	40 2	40 43	0	0	1	1	2	3	3	4	5	5	6
10	35 50	36 31	37 12	37 52	38 33	39 14	39 55	40 36	10	7	7	8	9	9	10	11	11	12	13
20	35 43	36 24	37 5	37 45	38 26	39 7	39 47	40 28	20	14	14	15	16	16	17	18	18	19	20
30	35 37	36 17	36 58	37 38	38 19	38 59	39 40	40 21	30	20	21	22	22	23	24	24	25	26	26
40	35 30	36 10	36 51	37 31	38 12	38 52	39 32	40 13	40	27	28	28	29	30	30	31	32	32	33
50	35 23	36 3	36 44	37 24	38 5	38 45	39 25	40 5	50	34	34	35	36	37	37	38	39	39	40
48 0	35 17	35 57	36 37	37 17	37 57	38 37	39 18	39 58	0	0	1	1	2	3	3	4	5	5	6
10	35 10	35 50	36 30	37 10	37 50	38 30	39 10	39 50	10	7	7	8	9	10	10	11	11	12	13
20	35 3	35 43	36 23	37 3	37 43	38 23	39 3	39 42	20	13	14	15	15	16	17	17	18	19	19
30	34 56	35 36	36 16	36 56	37 36	38 15	38 55	39 35	30	20	21	21	22	23	23	24	25	25	26
40	34 50	35 29	36 9	36 49	37 28	38 8	38 47	39 27	40	27	27	28	29	29	30	30	31	32	32
50	34 43	35 22	36 2	36 41	37 21	38 0	38 40	39 19	50	33	34	34	35	36	36	37	38	38	39
49 0	34 36	35 15	35 55	36 34	37 14	37 53	38 32	39 12	0	0	1	1	2	3	3	4	5	5	6
10	34 29	35 9	35 48	36 27	37 6	37 45	38 25	39 4	10	6	7	8	8	9	10	10	11	12	12
20	34 22	35 2	35 41	36 20	36 59	37 38	38 17	38 56	20	13	14	14	15	16	16	17	18	18	19
30	34 16	34 55	35 34	36 12	36 51	37 30	38 9	38 48	30	19	20	21	21	22	23	23	24	25	25
40	34 9	34 48	35 26	36 5	36 44	37 23	38 2	38 41	40	26	27	27	28	29	29	30	31	31	32
50	34 2	34 39	35 19	35 58	36 37	37 15	37 54	38 33	50	32	33	34	34	35	36	36	37	38	38

Prop. parts to min. of altit.	1′	2′	3′	4′	5′	6′	7′	8′	9′	Sub.
	1″	1″	2″	3″	3″	4″	5″	5″	6″	

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽ App altit.	Horizontal Parallax.								Prop. parts for Seconds of Par.										
	54′	55′	56′	57′	58′	59′	60′	61′		0″	1″	2″	3″	4″	5″	6″	7″	8″	9″
° ′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	″	″	″	″	″	″	″	″	″	″
50 0	33 55	34 33	35 12	35 51	36 29	37 8	37 46	38 25	0	0	1	1	2	3	3	4	4	5	6
10	33 48	34 26	35 5	35 43	36 22	37 0	37 39	38 17	10	6	7	7	8	9	10	10	11	11	12
20	33 41	34 19	34 58	35 36	36 14	30 52	37 31	38 9	20	13	13	14	15	15	16	17	17	18	18
30	33 34	34 12	34 50	35 28	36 7	36 45	37 23	38 1	30	19	20	20	21	22	22	23	24	24	25
40	33 27	34 5	34 43	35 21	35 59	36 37	37 15	37 53	40	25	26	27	27	28	29	29	30	31	31
50	33 20	33 58	34 36	35 14	35 52	36 29	37 7	37 45	50	32	32	33	34	34	35	36	36	37	38
51 0	33 13	33 51	34 28	35 6	35 44	36 22	36 59	37 37	0	0	1	1	2	2	3	4	4	5	6
10	33 6	33 43	34 21	34 59	35 36	36 14	36 52	37 29	10	6	7	7	8	9	9	10	11	11	12
20	32 59	33 36	34 14	34 51	35 29	36 6	36 44	37 21	20	12	13	14	14	15	16	16	17	17	18
30	32 52	33 29	34 6	34 44	35 21	35 58	36 36	37 13	30	19	19	20	21	21	22	22	23	24	24
40	32 45	33 22	33 59	34 36	35 13	35 50	30 28	37 5	40	25	26	26	27	28	29	29	30	30	31
50	32 37	33 14	33 52	34 29	35 6	35 42	36 20	36 57	50	31	32	32	33	34	34	35	35	36	37
52 0	32 30	33 7	33 44	34 21	34 58	35 35	36 12	36 49	0	0	1	1	2	2	3	4	4	5	5
10	32 23	33 0	33 37	34 13	34 50	35 27	36 4	36 41	10	6	7	7	8	9	9	10	10	11	12
20	32 16	32 53	33 29	34 6	34 43	35 19	35 56	36 33	20	12	13	13	14	15	15	16	16	17	18
30	32 9	32 45	33 22	33 58	34 35	35 11	35 48	36 24	30	18	19	19	20	21	21	22	23	23	24
40	32 1	32 38	33 14	33 51	34 27	35 3	35 40	36 16	40	24	25	26	26	27	27	28	29	29	30
50	31 54	32 30	33 7	33 43	34 19	34 55	35 32	36 8	50	30	31	32	32	33	33	34	35	35	36
53 0	31 47	32 23	32 59	33 35	34 11	34 48	35 24	36 0	0	0	1	1	2	2	3	4	4	5	5
10	31 40	32 16	32 52	33 28	34 4	34 40	35 15	35 51	10	6	6	7	8	8	9	10	10	11	11
20	31 32	32 8	32 44	33 20	33 56	34 32	35 7	35 43	20	12	12	13	14	14	15	15	16	17	17
30	31 25	32 1	32 36	33 12	33 48	34 24	34 59	35 35	30	18	18	19	20	20	21	21	22	23	23
40	31 18	31 53	32 29	33 4	33 40	34 15	34 51	35 27	40	24	24	25	26	26	27	27	28	29	29
50	31 10	31 46	32 21	32 57	33 32	34 7	34 43	35 18	50	30	30	31	32	32	33	33	34	35	35
54 0	31 3	31 38	32 13	32 49	33 24	33 59	34 35	35 10	0	0	1	1	2	2	3	3	4	5	5
10	30 56	31 31	32 6	32 41	33 16	33 51	34 26	35 2	10	6	6	7	8	8	9	9	10	10	11
20	30 48	31 23	31 58	32 33	33 8	33 43	34 18	34 53	20	12	12	13	13	14	15	15	16	16	17
30	30 41	31 16	31 51	32 25	33 0	33 35	34 10	34 45	30	17	18	19	19	20	20	21	21	22	23
40	30 33	31 8	31 43	32 18	32 52	33 27	34 2	34 36	40	23	24	24	25	26	26	27	27	28	28
50	30 26	31 1	31 35	32 10	32 44	33 19	33 53	34 28	50	29	30	30	31	31	32	32	33	34	34
55 0	30 19	30 53	31 27	32 2	32 36	33 11	33 45	34 19	0	0	1	1	2	2	3	3	4	5	5
10	30 11	30 45	31 20	31 54	32 28	33 2	33 37	34 11	10	6	6	7	7	8	8	9	10	10	11
20	30 4	30 38	31 12	31 46	32 20	32 54	33 28	34 2	20	11	12	12	13	14	14	15	15	16	16
30	29 56	30 30	31 4	31 38	32 12	32 46	33 20	33 54	30	17	18	18	19	19	20	20	21	22	22
40	29 48	30 22	30 56	31 30	32 4	32 38	33 12	33 45	40	23	23	24	24	25	25	26	27	27	28
50	29 41	30 15	30 47	31 22	31 56	32 29	33 3	33 37	50	28	29	29	30	31	31	32	32	33	33
56 0	29 33	30 7	30 40	31 14	31 48	32 21	32 55	33 28	0	0	1	1	2	2	3	3	4	4	5
10	29 26	29 59	30 33	31 6	31 39	32 13	32 46	33 20	10	6	6	7	7	8	8	9	9	10	10
20	29 18	29 51	30 25	30 58	31 31	32 4	32 38	33 11	20	11	12	12	13	13	14	14	15	15	16
30	29 11	29 44	30 17	30 50	31 23	31 56	32 29	33 2	30	17	17	18	18	19	19	20	20	21	22
40	29 3	29 36	30 9	30 42	31 15	31 48	32 21	32 54	40	22	23	23	24	24	25	25	26	26	27
50	28 55	29 28	30 1	30 34	31 7	31 39	32 12	32 45	50	28	28	29	29	30	30	31	31	32	33
57 0	28 48	29 20	29 53	30 26	30 58	31 31	32 4	32 36	0	0	1	1	2	2	[illegible]	3	4	4	5
10	28 40	29 12	29 45	30 18	30 50	31 23	31 55	32 28	10	5	6	6	7	8	8	9	9	10	10
20	28 32	29 5	29 37	30 9	30 42	31 14	31 47	32 19	20	11	11	12	12	13	13	14	14	15	16
30	28 25	28 57	29 29	30 1	30 34	31 6	31 38	32 10	30	16	17	17	18	18	19	19	20	20	21
40	28 17	28 49	29 21	29 53	30 25	30 57	31 29	32 1	40	21	22	23	23	24	24	25	25	26	26
50	28 9	28 41	29 13	29 45	30 17	30 49	31 21	31 53	50	27	27	28	28	29	30	30	31	31	32
58 0	28 1	28 33	29 5	29 37	30 9	30 40	31 12	31 44	0	0	1	1	2	2	3	3	4	4	5
10	27 54	28 25	28 57	29 29	30 0	30 32	31 3	31 35	10	5	6	6	7	7	8	8	9	9	10
20	27 46	28 17	28 49	29 20	29 52	30 23	30 55	31 26	20	10	11	11	12	13	13	14	14	15	15
30	27 38	28 9	28 41	29 12	29 43	30 15	30 46	31 17	30	16	16	17	17	18	18	19	19	20	20
40	27 30	28 1	28 33	29 4	29 35	30 6	30 37	31 9	40	21	21	22	22	23	23	24	25	25	26
50	27 22	27 53	28 24	28 55	29 27	29 58	30 29	31 0	50	26	27	27	28	28	29	29	30	30	31
59 0	27 15	27 45	28 16	28 47	29 18	29 49	30 20	30 51	0	0	1	1	2	2	3	3	4	4	5
10	27 7	27 37	28 8	28 39	29 10	29 40	30 11	30 42	10	5	6	6	7	7	8	8	9	9	10
20	26 59	27 29	28 0	28 31	29 1	29 32	30 2	30 33	20	10	11	11	12	12	13	13	14	14	15
30	26 51	27 21	27 51	28 22	28 53	29 23	29 54	30 24	30	15	16	16	17	17	18	18	19	19	20
40	26 43	27 13	27 44	28 14	28 44	29 14	29 45	30 15	40	20	21	21	22	22	23	23	24	24	25
50	26 35	27 5	27 35	28 6	28 36	29 6	29 36	30 6	50	25	26	26	27	27	28	28	29	29	30

Prop. parts to min. of altit.	1′	2′	3′	4′	5′	6′	7′	8′	9′	Sub.
	1″	2″	2″	3″	4″	5″	6″	6″	7″	

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽ App altit.		Horizontal Parallax.																Prop. parts for Seconds of Par.										
		54′		55′		56′		57′		58′		59′		60′		61′			0″	1″	2″	3″	4″	5″	6″	7″	8″	9″
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″	″	″	″	″	″
60	0	26	27	26	57	27	27	27	57	28	27	28	57	29	27	29	57	0	0	0	1	1	2	2	3	3	4	4
	10	26	19	26	49	27	19	27	49	28	19	28	48	29	19	29	48	10	5	5	6	6	7	7	8	8	9	9
	20	26	11	26	41	27	11	27	40	28	10	28	40	29	9	29	39	20	10	10	11	11	12	12	13	13	14	14
	30	26	3	26	33	27	2	27	32	28	1	28	31	29	0	29	30	30	15	15	16	16	17	17	18	18	19	19
	40	25	55	26	25	26	54	27	23	27	53	28	22	28	52	29	21	40	20	20	21	21	22	22	23	23	24	24
	50	25	47	26	16	26	46	27	15	27	44	28	13	28	43	29	12	50	25	25	26	26	27	27	28	28	29	29
61	0	25	39	26	8	26	37	27	6	27	36	28	5	28	34	29	3	0	0	0	1	1	2	2	3	3	4	4
	10	25	31	26	0	26	29	26	58	27	27	27	56	28	25	28	54	10	5	5	6	6	7	7	8	8	9	9
	20	25	23	25	52	26	21	26	49	27	18	27	47	28	16	28	45	20	10	10	10	11	11	12	12	13	13	14
	30	25	15	25	44	26	12	26	41	27	10	27	38	28	7	28	35	30	14	15	15	16	16	17	17	18	18	19
	40	25	7	25	35	26	4	26	32	27	1	27	29	27	58	28	26	40	19	20	20	21	21	21	22	22	23	23
	50	24	59	25	27	25	56	26	24	26	52	27	21	27	49	28	17	50	24	24	25	25	26	26	27	27	28	28
62	0	24	51	25	19	25	47	26	15	26	43	27	12	27	40	28	8	0	0	0	1	1	2	2	3	3	4	4
	10	24	43	25	11	25	39	26	7	26	35	27	3	27	31	27	59	10	5	5	6	6	6	7	7	8	8	9
	20	24	35	25	2	25	30	25	58	26	26	26	54	27	22	27	50	20	9	10	10	11	11	12	12	12	13	13
	30	24	26	24	54	25	22	25	50	26	17	26	45	27	13	27	40	30	14	14	15	15	16	16	17	17	18	18
	40	24	18	24	46	25	13	25	41	26	8	26	36	27	4	27	31	40	18	19	19	20	20	21	21	22	22	23
	50	24	10	24	37	25	5	25	32	26	0	26	27	26	54	27	22	50	23	24	24	24	25	25	26	26	27	27
63	0	24	2	24	29	24	56	25	25	25	51	26	18	26	45	27	13	0	0	0	1	1	2	2	3	3	4	4
	10	23	54	24	21	24	48	25	15	25	42	26	9	26	36	27	3	10	4	5	5	6	6	7	7	8	8	8
	20	23	45	24	12	24	39	25	6	25	33	26	0	26	27	26	54	20	9	9	10	10	11	11	12	12	12	13
	30	23	37	24	4	24	31	24	58	25	24	25	51	26	18	26	45	30	13	14	14	15	15	16	16	17	17	17
	40	23	29	23	56	24	22	24	49	25	15	25	42	26	9	26	35	40	18	18	19	19	20	20	21	21	21	22
	50	23	21	23	47	24	14	24	40	25	7	25	33	26	0	26	26	50	22	23	23	24	24	25	25	25	26	26
64	0	23	13	23	39	24	5	24	31	24	58	25	24	25	50	26	17	0	0	0	1	1	2	2	3	3	3	4
	10	23	4	23	30	23	57	24	22	24	49	25	15	25	41	26	7	10	4	5	5	6	6	6	7	7	8	8
	20	22	56	23	22	23	48	24	14	24	40	25	6	25	32	25	58	20	9	9	9	10	10	11	11	12	12	12
	30	22	48	23	14	23	39	24	5	24	31	24	57	25	23	25	48	30	13	13	14	14	15	15	15	16	16	17
	40	22	39	23	5	23	31	23	56	24	22	24	48	25	13	25	39	40	17	18	18	18	19	19	20	20	21	21
	50	22	31	22	57	23	22	23	48	24	13	24	39	25	4	25	30	50	22	22	22	23	23	24	24	25	25	25
65	0	22	23	22	48	23	13	23	39	24	4	24	30	24	55	25	20	0	0	0	1	1	2	2	2	3	3	4
	10	22	14	22	40	23	5	23	30	23	55	24	20	24	46	25	11	10	4	5	5	5	6	6	7	7	7	8
	20	22	6	22	31	22	56	23	21	23	46	24	11	24	36	25	1	20	8	9	9	10	10	10	11	11	12	12
	30	21	58	22	23	22	47	23	12	23	37	24	2	24	27	24	52	30	12	13	13	14	14	14	15	15	16	16
	40	21	49	22	14	22	39	23	3	23	28	23	53	24	18	24	43	40	17	17	17	18	18	19	19	19	20	20
	50	21	41	22	5	22	30	22	55	23	19	23	44	24	8	24	33	50	21	21	21	22	22	23	23	24	24	24
66	0	21	32	21	57	22	21	22	46	23	10	23	34	23	59	24	23	0	0	0	1	1	2	2	2	3	3	4
	10	21	24	21	48	22	13	22	37	23	1	23	25	23	50	24	14	10	4	4	5	5	6	6	6	7	7	8
	20	21	16	21	40	22	4	22	28	22	52	23	16	23	40	24	4	20	8	8	9	9	10	10	10	11	11	12
	30	21	7	21	31	21	55	22	19	22	43	23	7	23	31	23	55	30	12	12	13	13	14	14	14	15	15	16
	40	20	59	21	22	21	46	22	10	22	34	22	58	23	21	23	45	40	16	16	17	17	18	18	18	19	19	20
	50	20	50	21	14	21	37	22	1	22	25	22	48	23	12	23	35	50	20	20	21	21	21	22	22	23	23	23
67	0	20	42	21	5	21	29	21	52	22	16	22	39	23	2	23	26	0	0	0	1	1	2	2	2	3	3	3
	10	20	33	20	57	21	20	21	43	22	6	22	30	22	53	23	16	10	4	4	5	5	5	6	6	6	7	7
	20	20	25	20	48	21	11	21	34	21	57	22	20	22	44	23	7	20	8	8	8	9	9	10	10	10	11	11
	30	20	16	20	39	21	2	21	25	21	48	22	11	22	34	22	57	30	11	12	12	13	13	13	14	14	14	15
	40	20	7	20	31	20	53	21	16	21	39	22	2	22	25	22	47	40	15	16	16	16	17	17	18	18	18	19
	50	19	59	20	22	20	45	21	7	21	30	21	52	22	15	22	38	50	19	19	20	20	21	21	21	22	22	22
68	0	19	51	20	13	20	36	20	58	21	21	21	43	22	6	22	28	0	0	0	1	1	2	2	2	3	3	3
	10	19	42	20	4	20	27	20	49	21	11	21	34	21	56	22	18	10	4	4	4	5	5	5	6	6	7	7
	20	19	34	19	56	20	18	20	40	21	2	21	24	21	47	22	9	20	7	8	8	8	9	9	10	10	10	11
	30	19	25	19	47	20	9	20	31	20	53	21	15	21	37	21	59	30	11	11	12	12	12	13	13	14	14	14
	40	19	16	19	38	20	0	20	22	20	44	21	6	21	27	21	49	40	15	15	15	16	16	16	17	17	18	18
	50	19	8	19	30	19	51	20	13	20	35	20	56	21	18	21	39	50	18	19	19	19	20	20	20	21	21	22
69	0	18	59	19	21	19	42	20	4	20	25	20	47	21	8	21	30	0	0	0	1	1	1	2	2	2	3	3
	10	18	51	19	12	19	33	19	55	20	16	20	37	20	58	21	20	10	4	4	4	5	5	5	6	6	6	7
	20	18	42	19	3	19	24	19	46	20	7	20	28	20	49	21	10	20	7	7	8	8	8	9	9	9	10	10
	30	18	33	18	54	19	15	19	36	19	57	20	18	20	39	21	0	30	11	11	11	12	12	12	13	13	13	14
	40	18	25	18	46	19	6	19	27	19	48	20	9	20	30	20	51	40	14	14	15	15	15	16	16	16	17	17
	50	18	15	18	36	18	56	19	17	19	38	19	59	20	19	20	40	50	18	18	18	19	19	19	20	20	20	21

Prop. parts to min. of altit.	1′	2′	3′	4′	5′	6′	7′	8′	9′	Sub.
	1″	2″	3″	4″	4″	5″	6″	7″	8″	

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽ App altit.		Horizontal Parallax.																Prop. parts for Seconds of Par.										
		54′		55′		56′		57′		58′		59′		60′		61′			0″	1″	2″	3″	4″	5″	6″	7″	8″	9″
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″	″	″	″	″	″
70	0	18	7	18	28	18	48	19	9	19	30	19	50	20	11	20	31	0	0	0	1	1	1	2	2	2	3	3
	10	17	59	18	19	18	39	19	0	19	20	19	41	20	1	20	21	10	3	4	4	4	5	5	5	6	6	6
	20	17	50	18	10	18	30	18	51	19	11	19	31	19	51	20	11	20	7	7	7	8	8	8	9	9	9	0
	30	17	41	18	1	18	21	18	41	19	1	19	22	19	42	20	2	30	10	10	11	11	11	12	12	12	13	13
	40	17	33	17	53	18	12	18	32	18	52	19	12	19	32	19	52	40	13	14	14	14	15	15	15	16	16	16
	50	17	24	17	44	18	3	18	23	18	43	19	2	19	22	19	42	50	17	17	17	18	18	18	19	19	19	20
71	0	17	15	17	35	17	54	18	14	18	33	18	53	19	12	19	32	0	0	0	1	1	1	2	2	2	3	3
	10	17	6	17	26	17	45	18	5	18	24	18	43	19	3	19	22	10	3	3	4	4	4	5	5	5	6	6
	20	16	58	17	17	17	36	17	55	18	15	18	34	18	53	19	12	20	6	7	7	7	8	8	8	9	9	9
	30	16	50	17	8	17	27	17	46	18	5	18	24	18	43	19	2	30	10	10	10	10	11	11	11	12	12	12
	40	16	40	16	59	17	18	17	37	17	56	18	15	18	33	18	52	40	13	13	13	14	14	14	15	15	15	16
	50	16	31	16	50	17	9	17	28	17	46	18	5	18	24	18	42	50	16	16	16	17	17	17	18	18	18	19
72	0	16	23	16	41	17	0	17	18	17	37	17	55	18	14	18	32	0	0	0	1	1	1	2	2	2	2	3
	10	16	14	16	32	16	51	17	9	17	27	17	46	18	4	18	23	10	3	3	4	4	4	5	5	5	5	6
	20	16	5	16	23	16	42	17	0	17	18	17	36	17	54	18	13	20	6	6	7	7	7	8	8	8	8	9
	30	15	56	16	14	16	32	16	50	17	9	17	26	17	45	18	3	30	9	9	10	10	10	11	11	11	11	12
	40	15	48	16	5	16	23	16	41	16	59	17	17	17	35	17	53	40	12	12	13	13	13	14	14	14	14	15
	50	15	39	15	56	16	14	16	32	16	50	17	7	17	25	17	43	50	15	15	16	16	16	17	17	17	17	18
73	0	15	30	15	47	16	5	16	22	16	40	16	58	17	15	17	33	0	0	0	1	1	1	1	2	2	2	3
	10	15	21	15	38	15	56	16	13	16	31	16	48	17	5	17	23	10	3	3	3	4	4	4	5	5	5	5
	20	15	12	15	29	15	47	16	4	16	21	16	38	16	55	17	13	20	6	6	6	7	7	7	7	8	8	8
	30	15	3	15	20	15	37	15	54	16	12	16	29	16	46	17	3	30	9	9	9	9	10	10	10	11	11	11
	40	14	54	15	11	15	28	15	45	16	2	16	19	16	36	16	53	40	11	12	12	12	12	13	13	13	14	14
	50	14	46	15	2	15	19	15	36	15	52	16	9	16	26	16	43	50	14	14	15	15	15	16	16	16	16	17
74	0	14	37	14	53	15	10	15	26	15	43	15	59	16	16	16	33	0	0	0	1	1	1	1	2	2	2	2
	10	14	28	14	44	15	1	15	17	15	33	15	50	16	6	16	22	10	3	3	3	3	4	4	4	5	5	5
	20	14	19	14	35	14	51	15	8	15	24	15	40	15	56	16	12	20	5	6	6	6	6	7	7	7	7	8
	30	14	10	14	26	14	42	14	58	15	14	15	30	15	46	16	2	30	8	8	9	9	9	9	10	10	10	10
	40	14	1	14	17	14	33	14	49	15	5	15	20	15	36	15	52	40	11	11	11	11	12	12	12	13	13	13
	50	13	52	14	8	14	24	14	39	14	55	15	11	15	26	15	42	50	13	14	14	14	14	15	15	15	15	16
75	0	13	43	13	59	14	14	14	30	14	45	15	1	15	16	15	32	0	0	0	1	1	1	1	2	2	2	2
	10	13	34	13	50	14	5	14	20	14	36	14	51	15	7	15	22	10	3	3	3	3	4	4	4	4	5	5
	20	13	25	13	41	13	56	14	11	14	26	14	41	14	57	15	12	20	5	5	6	6	6	6	7	7	7	7
	30	13	16	13	32	13	47	14	2	14	17	14	32	14	47	15	2	30	8	8	8	8	9	9	9	9	10	10
	40	13	8	13	22	13	37	13	52	14	7	14	22	14	37	14	52	40	10	10	11	11	11	11	12	12	12	12
	50	12	59	13	13	13	28	13	43	13	57	14	12	14	27	14	41	50	13	13	13	13	14	14	14	14	15	15
76	0	12	50	13	4	13	19	13	33	13	48	14	2	14	17	14	31	0	0	0	0	1	1	1	1	2	2	2
	10	12	41	12	55	13	9	13	24	13	38	13	52	14	7	14	21	10	2	3	3	3	3	3	4	4	4	4
	20	12	32	12	46	13	0	13	14	13	28	13	43	13	57	14	11	20	5	5	5	5	6	6	6	6	7	7
	30	12	23	12	37	12	51	13	5	13	19	13	33	13	47	14	1	30	7	7	7	8	8	8	8	9	9	9
	40	12	14	12	28	12	41	12	55	13	9	13	23	13	37	13	51	40	9	10	10	10	10	10	11	11	11	11
	50	12	5	12	18	12	32	12	46	12	59	13	13	13	27	13	40	50	12	12	12	12	13	13	13	13	14	14
77	0	11	56	12	9	12	23	12	36	12	50	13	3	13	17	13	30	0	0	0	0	1	1	1	1	2	2	2
	10	11	47	12	0	12	13	12	27	12	40	12	53	13	7	13	20	10	2	2	3	3	3	3	4	4	4	4
	20	11	38	11	51	12	4	12	17	12	30	12	43	12	57	13	10	20	4	5	5	5	5	6	6	6	6	6
	30	11	29	11	42	11	55	12	8	12	21	12	34	12	47	13	0	30	7	7	7	7	7	8	8	8	8	9
	40	11	20	11	32	11	45	11	58	12	11	12	24	12	37	12	49	40	9	9	9	9	10	10	10	10	10	11
	50	11	11	11	23	11	36	11	49	12	1	12	14	12	26	12	39	50	11	11	11	12	12	12	12	12	13	13
78	0	11	2	11	14	11	26	11	39	11	51	12	4	12	16	12	29	0	0	0	0	1	1	1	1	1	2	2
	10	10	52	11	5	11	17	11	29	11	42	11	54	12	6	12	19	10	2	2	2	3	3	3	3	3	4	4
	20	10	43	10	56	11	8	11	20	11	32	11	44	11	56	12	8	20	4	4	4	5	5	5	5	5	6	6
	30	10	34	10	46	10	58	11	10	11	22	11	34	11	46	11	58	30	6	6	6	7	7	7	7	7	8	8
	40	10	25	10	37	10	49	11	1	11	12	11	24	11	36	11	48	40	8	8	8	9	9	9	9	9	10	10
	50	10	16	10	28	10	39	10	51	11	3	11	14	11	26	11	38	50	10	10	10	11	11	11	11	11	12	12
79	0	10	7	10	19	10	30	10	41	10	53	11	4	11	16	11	27	0	0	0	0	1	1	1	1	1	1	2
	10	9	58	10	9	10	21	10	32	10	43	10	54	11	6	11	17	10	2	2	2	2	3	3	3	3	3	3
	20	9	49	10	0	10	11	10	22	10	33	10	44	10	56	11	7	20	4	4	4	4	4	5	5	5	5	5
	30	9	40	9	51	10	2	10	13	10	24	10	35	10	46	10	57	30	5	6	6	6	6	6	7	7	7	7
	40	9	31	9	42	9	52	10	3	10	14	10	25	10	35	10	46	40	7	7	8	8	8	8	8	9	9	9
	50	9	22	9	32	9	43	9	53	10	4	10	15	10	25	10	36	50	9	9	9	10	10	10	10	11	11	11

Prop. parts to min. of altit.	1′	2′	3′	4′	5′	6′	7′	8′	9′	Sub.
	1″	2″	3″	4″	5″	6″	7″	8″	9″	

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽ App altit.		Horizontal Parallax.																Prop. parts for Seconds of Par.										
		54′		55′		56′		57′		58′		59′		60′		61′			0″	1″	2″	3″	4″	5″	6″	7″	8″	9″
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″	″	″	″	″	″
80	0	9	13	9	23	9	33	9	44	9	54	10	5	10	15	10	25	0	0	0	0	0	1	1	1	1	1	1
	10	9	3	9	14	9	24	9	34	9	44	9	55	10	5	10	15	10	2	2	2	2	2	2	3	3	3	3
	20	8	54	9	4	9	15	9	25	9	35	9	45	9	55	10	5	20	3	3	4	4	4	4	4	4	5	5
	30	8	45	8	55	9	5	9	15	9	25	9	35	9	45	9	55	30	5	5	5	5	6	6	6	6	6	6
	40	8	36	8	46	8	56	9	5	9	15	9	25	9	34	9	44	40	7	7	7	7	7	7	8	8	8	8
	50	8	27	8	37	8	46	8	56	9	5	9	15	9	24	9	34	50	8	8	9	9	9	9	9	9	10	10
81	0	8	18	8	27	8	37	8	46	8	55	9	5	9	14	9	24	0	0	0	0	0	1	1	1	1	1	1
	10	8	9	8	18	8	27	8	36	8	46	8	55	9	4	9	13	10	1	2	2	2	2	2	2	3	3	3
	20	8	0	8	9	8	18	8	27	8	36	8	45	8	54	9	3	20	3	3	3	3	4	4	4	4	4	4
	30	7	50	7	59	8	8	8	17	8	26	8	35	8	44	8	52	30	4	5	5	5	5	5	5	5	6	6
	40	7	41	7	50	7	59	8	7	8	16	8	25	8	33	8	42	40	6	6	6	6	7	7	7	7	7	7
	50	7	32	7	41	7	49	7	58	8	6	8	15	8	23	8	32	50	7	8	8	8	8	8	8	8	9	9
82	0	7	23	7	31	7	40	7	48	7	56	8	5	8	13	8	21	0	0	0	0	0	1	1	1	1	1	1
	10	7	14	7	22	7	30	7	38	7	46	7	55	8	3	8	11	10	1	1	2	2	2	2	2	2	2	2
	20	7	5	7	13	7	21	7	29	7	37	7	45	7	53	8	1	20	3	3	3	3	3	3	3	4	4	4
	30	6	55	7	3	7	11	7	19	7	27	7	35	7	42	7	50	30	4	4	4	4	4	5	5	5	5	5
	40	6	46	6	54	7	2	7	9	7	17	7	25	7	32	7	40	40	5	5	5	6	6	6	6	6	6	6
	50	6	37	6	45	6	52	7	0	7	7	7	14	7	22	7	29	50	7	7	7	7	7	7	7	7	8	8
83	0	6	28	6	35	6	42	6	50	6	57	7	4	7	12	7	19	0	0	0	0	0	0	1	1	1	1	1
	10	6	19	6	26	6	33	6	40	6	47	6	54	7	2	7	9	10	1	1	1	1	2	2	2	2	2	2
	20	6	9	6	16	6	23	6	30	6	37	6	44	6	51	6	58	20	2	2	2	3	3	3	3	3	3	3
	30	6	0	6	7	6	14	6	21	6	27	6	34	6	41	6	48	30	3	4	4	4	4	4	4	4	4	4
	40	5	51	5	58	6	4	6	11	6	18	6	24	6	31	6	37	40	5	5	5	5	5	5	5	5	5	6
	50	5	42	5	48	5	55	6	1	6	8	6	14	6	21	6	27	50	6	6	6	6	6	6	6	6	7	7
84	0	5	33	5	39	5	45	5	52	5	58	6	4	6	10	6	17	0	0	0	0	0	0	0	1	1	1	1
	10	5	23	5	30	5	36	5	42	5	48	5	54	6	0	6	6	10	1	1	1	1	1	1	2	2	2	2
	20	5	14	5	20	5	26	5	32	5	58	5	44	5	50	5	56	20	2	2	2	2	2	2	2	3	3	3
	30	5	5	5	11	5	17	5	22	5	28	5	34	5	40	5	45	30	3	3	3	3	3	3	3	4	4	4
	40	4	56	5	1	5	7	5	13	5	18	5	24	5	29	5	35	40	4	4	4	4	4	4	4	5	5	5
	50	4	47	4	52	4	57	5	3	5	8	5	14	5	19	5	24	50	5	5	5	5	5	5	5	5	6	6
85	0	4	37	4	43	4	48	4	53	4	58	5	4	5	9	5	14	0	0	0	0	0	0	0	0	1	1	1
	10	4	28	4	33	4	38	4	43	4	48	4	53	4	59	5	4	10	1	1	1	1	1	1	1	1	1	1
	20	4	19	4	24	4	29	4	34	4	38	4	43	4	48	4	53	20	2	2	2	2	2	2	2	2	2	2
	30	4	10	4	14	4	19	4	24	4	29	4	33	4	38	4	43	30	2	2	2	3	3	3	3	3	3	3
	40	4	0	4	5	4	10	4	14	4	19	4	23	4	28	4	32	40	3	3	3	3	3	4	4	4	4	4
	50	3	51	3	56	4	0	4	4	4	9	4	13	4	17	4	22	50	4	4	4	4	4	4	4	4	5	5
86	0	3	42	3	46	3	50	3	55	3	59	4	3	4	7	4	11	0	0	0	0	0	0	0	0	0	0	1
	10	3	33	3	37	3	41	3	45	3	49	3	53	3	57	4	1	10	1	1	1	1	1	1	1	1	1	1
	20	3	24	3	27	3	31	3	35	3	39	3	43	3	47	3	50	20	1	1	1	1	1	2	2	2	2	2
	30	3	14	3	18	3	22	3	25	3	29	3	33	3	36	3	40	30	2	2	2	2	2	2	2	2	2	2
	40	3	5	3	9	3	12	3	16	3	19	3	23	3	26	3	30	40	2	3	3	3	3	3	3	3	3	3
	50	2	56	2	59	3	2	3	6	3	9	3	12	3	16	3	19	50	3	3	3	3	3	3	3	3	4	4
87	0	2	46	2	50	2	53	2	56	2	59	3	2	3	5	3	9	0	0	0	0	0	0	0	0	0	0	0
	10	2	37	2	40	2	43	2	46	2	49	2	52	2	55	2	58	10	0	0	1	1	1	1	1	1	1	1
	20	2	28	2	31	2	34	2	36	2	39	2	42	2	45	2	48	20	1	1	1	1	1	1	1	1	1	1
	30	2	19	2	21	2	24	2	27	2	29	2	32	2	35	2	37	30	1	1	1	1	1	2	2	2	2	2
	40	2	10	2	12	2	14	2	17	2	19	2	22	2	24	2	27	40	2	2	2	2	2	2	2	2	2	2
	50	2	0	2	3	2	5	2	7	2	9	2	12	2	14	2	16	50	2	2	2	2	2	2	2	2	3	3
88	0	1	51	1	53	1	55	1	57	1	59	2	2	2	4	2	6	0	0	0	0	0	0	0	0	0	0	0
	10	1	42	1	44	1	46	1	48	1	50	1	51	1	53	1	55	10	0	0	0	0	0	0	0	0	0	0
	20	1	33	1	34	1	36	1	38	1	40	1	41	1	43	1	45	20	1	1	1	1	1	1	1	1	1	1
	30	1	23	1	25	1	26	1	28	1	30	1	31	1	33	1	34	30	1	1	1	1	1	1		1	1	1
	40	1	14	1	15	1	17	1	18	1	20	1	21	1	22	1	24	40	1	1	1	1	1	1	1	1	1	1
	50	1	5	1	6	1	7	1	8	1	10	1	11	1	12	1	13	50	1	1	1	1	1	1	1	1	2	2
89	0	0	56	0	57	0	58	0	59	1	0	1	1	1	2	1	3	0	0	0	0	0	0	0	0	0	0	0
	10	0	46	0	47	0	48	0	49	0	50	0	51	0	52	0	52	10	0	0	0	0	0	0	0	0	0	0
	20	0	37	0	38	0	38	0	39	0	40	0	41	0	41	0	42	20	0	0	0	0	0	0	0	0	0	0
	30	0	28	0	28	0	29	0	29	0	30	0	30	0	31	0	31	30	0	0	0	0	0	0	0	0	0	0
	40	0	18	0	19	0	19	0	20	0	20	0	20	0	21	0	21	40	0	0	0	0	0	0		0	0	0
	50	0	9	0	9	0	10	0	10	0	10	0	10	0	10	0	10	50	1	1	1	1	1	1		1	1	1

Prop. parts to min. of altit. { 1′ 2′ 3′ 4′ 5′ 6′ 7′ 8′ 9′ / 1″ 2″ 3″ 4″ 5″ 6″ 7″ 8″ 9″ } Sub.

TABLE XXXI.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	Moon's Apparent Altitude.					Diff. to 100'
	3°	4	5°	6°	7°	
53' 0"	9.999839	9727	9612	9496	9380	193
10	9838	9725	9610	9494	9377	193
20	9837	9723	9608	9491	9374	194
30	9835	9721	9606	9489	9371	194
40	9833	9720	9604	9486	9369	195
50	9832	9718	9602	9484	9366	195
54 0	9.999831	9716	9599	9481	9363	196
10	9830	9714	9597	9479	9360	196
20	9829	9713	9595	9476	9357	197
30	9827	9711	9593	9474	9354	197
40	9826	9709	9591	9471	9351	198
50	9824	9707	9589	9469	9348	199
55 0	9.999823	9706	9587	9466	9345	200
10	9821	9704	9584	9464	9342	200
20	9820	9702	9582	9461	9339	201
30	9819	9700	9580	9459	9337	201
40	9817	9699	9578	9456	9334	202
50	9816	9697	9576	9454	9331	202
56 0	9.999815	9695	9574	9451	9328	203
10	9813	9693	9571	9449	9325	203
20	9812	9692	9569	9447	9322	204
30	9811	9690	9567	9444	9320	205
40	9809	9688	9565	9442	9317	205
50	9808	9686	9563	9439	9314	206
57 0	9.999807	9685	9561	9437	9311	207
10	9805	9683	9559	9434	9308	207
20	9804	9681	9557	9432	9305	208
30	9803	9680	9555	9429	9303	209
40	9801	9678	9553	9427	9300	209
50	9800	9676	9551	9424	9297	210
58 0	9.999799	9675	9549	9422	9294	211
10	9797	9673	9546	9419	9291	211
20	9796	9671	9544	9417	9288	212
30	9794	9669	9542	9414	9286	212
40	9793	9668	9540	9412	9283	213
50	9791	9666	9538	9409	9280	214
59 0	9.999790	9664	9536	9407	9277	214
10	9789	9662	9533	9404	9274	215
20	9787	9661	9531	9402	9271	216
30	9786	9659	9529	9399	9268	217
40	9785	9657	9527	9397	9265	217
50	9783	9655	9525	9394	9262	218
60 0	9.999782	9653	9523	9392	9259	218
10	9781	9652	9520	9389	9257	219
20	9779	9650	9518	9387	9254	219
30	9778	9648	9516	9384	9251	220
40	9777	9646	9514	9382	9248	220
50	9775	9645	9512	9379	9245	221
61 0	9.999774	9643	9510	9376	9242	222
10	9772	9641	9507	9374	9239	223
20	9771	9639	9505	9371	9236	223
30	9769	9638	9503	9369	9233	224
40	9768	9636	9501	9366	9230	225
50	9766	9634	9499	9364	9227	225
62 0	9.999765	9632	9497	9361	9224	226

P. parts to sec. of par.	1"	2"	3"	4"	5"	6"	7"	8"	9"	Sub.
	0	0	1	1	1	1	2	2	2	

Sun's Alt.	5°	6°	7°	10°	15°	20°	30	40°	60	90°
Corr. Sub.	14	11	9	7	6	8	10	12	16	19

Moon's Hor. Par.	Moon's Apparent Altitude.					Diff. to 100'
	8°	9°	10°	11°	12°	
53' 0"	9.999264	9148	9032	8917	8803	192
10	9261	9144	9028	8913	8798	192
20	9257	9140	9024	8908	8794	193
30	9254	9137	9021	8904	8789	194
40	9251	9133	9017	8900	8784	194
50	9247	9129	9013	8895	8779	195
54 0	9.999244	9126	9009	8891	8774	196
10	9241	9122	9005	8887	8770	197
20	9238	9119	9001	8882	8765	197
30	9234	9115	8997	8878	8760	198
40	9231	9112	8993	8874	8756	199
50	9228	9108	8989	8869	8751	199
55 0	9.999225	9105	8985	8865	8746	200
10	9222	9101	8981	8860	8742	201
20	9219	9098	8977	8856	8737	201
30	9216	9094	8973	8852	8732	202
40	9212	9091	8969	8847	8727	202
50	9209	9087	8965	8843	8722	203
56 0	9.999206	9083	8961	8839	8718	203
10	9203	9079	8957	8834	8713	204
20	9199	9076	8953	8830	8708	205
30	9196	9072	8949	8826	8704	205
40	9193	9069	8945	8821	8699	206
50	9190	9066	8941	8817	8694	206
57 0	9.999186	9062	8937	8813	8690	207
10	9183	9058	8934	8809	8685	208
20	9180	9055	8930	8804	8680	209
30	9176	9051	8926	8800	8676	210
40	9173	9048	8922	8795	8671	211
50	9170	9044	8918	8791	8666	212
58 0	9.999167	9040	8914	8787	8662	212
10	9163	9037	8910	8782	8657	213
20	9160	9033	8906	8778	8652	213
30	9157	9029	8902	8774	8648	214
40	9154	9026	8898	8769	8643	214
50	9151	9022	8894	8765	8638	215
59 0	9.999147	9018	8890	8761	8634	215
10	9144	9014	8886	8756	8629	216
20	9141	9011	8882	8752	8624	216
30	9137	9007	8878	8748	8619	217
40	9134	9004	8874	8743	8615	217
50	9131	9000	8870	8739	8610	218
60 0	9.999128	8997	8866	8735	8605	218
10	9124	8993	8862	8730	8600	219
20	9121	8990	8858	8726	8596	220
30	9118	8986	8854	8722	8591	220
40	9115	8982	8850	8717	8586	221
50	9112	8979	8846	8713	8581	222
61 0	9.999108	8975	8842	8709	8577	222
10	9105	8971	8838	8704	8572	223
20	9102	8968	8834	8700	8567	223
30	9098	8964	8830	8695	8562	224
40	9095	8960	8826	8691	8558	224
50	9092	8957	8822	8687	8553	225
62 0	9.999089	8953	8818	8683	8548	225

P. parts to sec. of par.	1"	2"	3"	4"	5"	6"	7"	8"	9"	Sub.
	0	1	1	1	2	2	2	3	3	

Star's Alt.	5°	6°	7°	8°	9°	10°	15°	20°	25°	30°
Corr. Sub.	12	9	7	6	5	4	1	1	1	0

TABLE XXXI.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	Moon's Apparent Altitude. 13°	14°	15°	16°	17°	Diff. to 100′	Moon's Hor. Par.	Moon's Apparent Altitude. 18°	19°	20°	21°	22°	Diff. to 100′
53′ 0″	9.998688	8574	8461	8348	8236	188	53′ 0″	9.998124	8013	7902	7793	7684	184
10	8683	8569	8455	8342	8230	189	10	8117	8006	7895	7785	7675	185
20	8678	8563	8449	8336	8223	190	10	8110	7998	7887	7777	7667	185
30	8673	8558	8443	8329	8217	191	30	8104	7991	7880	7769	7659	186
40	8668	8553	8437	8323	8210	191	40	8097	7984	7872	7761	7651	186
50	8663	8547	8432	8317	8203	192	50	8090	7977	7865	7753	7643	187
54 0	9.998658	8542	8426	8311	8197	192	54 0	9.998083	7970	7857	7745	7635	187
10	8653	8537	8420	8305	8190	193	10	8076	7963	7850	7737	7626	188
20	8648	8531	8414	8299	8184	193	20	8069	7955	7842	7730	7618	188
30	8643	8526	8409	8293	8177	194	30	8063	7948	7835	7722	7610	189
40	8638	8521	8403	8287	8171	195	40	8056	7941	7827	7714	7602	189
50	8633	8515	8397	8281	8164	195	50	8049	7934	7820	7706	7594	190
55 0	9.998628	8510	8391	8275	8158	196	55 0	9.998042	7927	7812	7698	7586	190
10	8623	8504	8386	8269	8151	196	10	8035	7920	7805	7690	7577	191
20	8618	8498	8380	8262	8145	197	20	8028	7913	7798	7683	7569	191
30	8613	8493	8374	8256	8138	197	30	8022	7905	7790	7675	7561	192
40	8607	8488	8368	8250	8132	198	40	8015	7898	7782	7667	7553	192
50	8602	8482	8363	8244	8125	198	50	8008	7891	7775	7659	7545	193
56 0	9.998597	8477	8357	8238	8119	199	56 0	9.998001	7884	7767	7651	7537	193
10	8592	8471	8351	8232	8112	199	10	7994	7877	7760	7644	7528	194
20	8587	8466	8345	8225	8106	200	20	7987	7869	7752	7636	7520	194
30	8582	8460	8339	8219	8099	201	30	7981	7862	7745	7628	7512	195
40	8577	8455	8334	8213	8093	201	40	7974	7855	7737	7620	7504	196
50	8572	8449	8328	8207	8086	202	50	7967	7848	7730	7612	7495	196
57 0	9.998567	8444	8322	8201	8080	202	57 0	9.997960	7841	7722	7604	7487	197
10	8562	8439	8316	8195	8073	203	10	7953	7834	7715	7596	7479	198
20	8557	8433	8311	8189	8067	203	20	7946	7826	7707	7588	7470	198
30	8552	8428	8305	8183	8060	204	30	7940	7819	7700	7580	7462	199
40	8546	8423	8299	8177	8054	205	40	7933	7812	7692	7572	7454	200
50	8541	8418	8294	8171	8047	206	50	7926	7805	7685	7564	7446	200
58 0	9.998536	8412	8288	8165	8041	206	58 0	9.997919	7798	7677	7556	7438	201
10	8531	8407	8282	8159	8034	207	10	7912	7790	7670	7549	7429	201
20	8526	8401	8276	8152	8028	207	20	7905	7783	7662	7541	7421	202
30	8521	8396	8271	8146	8021	208	30	7899	7776	7655	7533	7413	203
40	8516	8391	8265	8140	8015	209	40	7892	7769	7647	7525	7405	203
50	8511	8385	8259	8134	8008	209	50	7885	7762	7640	7517	7396	204
59 0	9.998506	8380	8253	8128	8002	210	59 0	9.997878	7754	7632	7509	7388	204
10	8501	8374	8247	8122	7995	211	10	7871	7747	7625	7501	7380	205
20	8496	8369	8241	8115	7989	211	20	7864	7740	7617	7493	7371	205
30	8491	8363	8236	8109	7982	212	30	7858	7733	7610	7486	7363	206
40	8486	8358	8230	8103	7976	212	40	7851	7725	7602	7478	7355	206
50	8481	8352	8224	8097	7969	213	50	7844	7718	7594	7470	7347	207
60 0	9.998476	8347	8218	8091	7963	213	60 0	9.997837	7711	7586	7462	7339	207
10	8471	8341	8212	8085	7956	214	10	7830	7704	7579	7454	7330	208
20	8466	8336	8206	8078	7950	215	20	7823	7696	7571	7446	7322	208
30	8461	8330	8201	8072	7943	215	30	7817	7689	7564	7438	7314	209
40	8455	8325	8195	8066	7937	216	40	7810	7682	7556	7430	7306	210
50	8450	8319	8189	8060	7930	216	50	7803	7675	7549	7422	7297	211
61 0	9.998445	8314	8183	8054	7924	217	61 0	9.997796	7667	7541	7414	7290	211
10	8440	8308	8177	8047	7917	217	10	7789	7660	7534	7407	7281	212
20	8435	8303	8171	8041	7911	218	20	7782	7653	7526	7399	7273	213
30	8430	8297	8165	8035	7904	218	30	7775	7646	7519	7391	7265	214
40	8425	8292	8160	8029	7898	219	40	7768	7638	7511	7383	7257	214
50	8420	8286	8154	8023	7891	219	50	7761	7631	7504	7375	7248	215
62 0	9.998415	8281	8149	8017	7885	220	62 0	9.997754	7624	7496	7367	7240	216

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	1	1	2	2	3	4	4	5	5	
Sun's Alt.	5°	6°	7°	10°	15°	20°	30°	40°	60°	90°
Corr. Sub.	14	11	9	7	6	8	10	12	16	19

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	1	1	2	3	4	4	5	6	6	
Star's Alt.	5°	6°	7°	8°	9°	10°	15°	20°	25°	30°
Corr. Sub.	12	9	7	6	5	4	1	1	1	0

TABLE XXXI.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	Moon's Apparent Altitude. 23°	24	25°	26°	27°	Diff. to 100′	Moon's Hor. Par.	Moon's Apparent Altitude. 28°	29°	30°	31°	32°	Diff. to 100′
53′ 0″	9.997576	7468	7362	7256	7152	176	53′ 0″	9.997048	6945	6844	6743	6643	168
10	7567	7459	7353	7247	7142	177	10	7038	6935	6833	6732	6632	169
20	7559	7450	7344	7238	7132	177	20	7028	6924	6822	6720	6620	169
30	7550	7442	7334	7228	7122	178	30	7017	6914	6812	6709	6609	170
40	7541	7433	7325	7218	7112	179	40	7007	6903	6801	6698	6597	170
50	7533	7424	7316	7209	7102	179	50	6997	6893	6790	6687	6586	171
54 0	9.997524	7415	7307	7199	7092	180	54 0	9.996987	6882	6779	6676	6574	172
10	7516	7406	7297	7190	7082	180	10	6977	6871	6768	6665	6563	172
20	7507	7397	7288	7180	7072	181	20	6966	6861	6757	6653	6551	173
30	7499	7388	7279	7171	7063	182	30	6956	6850	6746	6642	6540	173
40	7490	7380	7270	7161	7053	182	40	6946	6840	6735	6631	6528	174
50	7482	7371	7260	7152	7043	183	50	6936	6829	6724	6620	6517	174
55 0	9.997473	7362	7251	7142	7033	183	55 0	9.996926	6819	6713	6609	6505	175
10	7464	7353	7242	7132	7023	184	10	6915	6808	6703	6597	6494	176
20	7456	7344	7233	7123	7013	184	20	6905	6798	6692	6586	6482	176
30	7447	7335	7223	7113	7003	185	30	6895	6787	6681	6575	6471	177
40	7439	7326	7214	7103	6993	186	40	6885	6776	6670	6564	6459	177
50	7430	7318	7205	7094	6983	186	50	6875	6766	6659	6553	6448	178
56 0	9.997421	7309	7196	7084	6973	187	56 0	9.996864	6755	6648	6541	6436	178
10	7413	7300	7187	7075	6964	187	10	6854	6745	6638	6530	6425	179
20	7404	7291	7177	7065	6954	188	20	6844	6734	6627	6519	6413	179
30	7396	7282	7168	7056	6944	188	30	6834	6724	6616	6508	6402	180
40	7387	7273	7159	7046	6934	189	40	6824	6713	6605	6497	6390	181
50	7379	7264	7149	7037	6924	189	50	6813	6703	6594	6486	6379	181
57 0	9.997370	7255	7140	7027	6914	190	57 0	9.996803	6692	6583	6474	6367	182
10	7361	7246	7131	7018	6904	190	10	6793	6682	6573	6463	6356	182
20	7353	7237	7122	7008	6894	191	20	6783	6671	6562	6452	6344	183
30	7344	7228	7113	6999	6884	191	30	6772	6661	6551	6441	6333	184
40	7336	7220	7103	6989	6875	192	40	6762	6650	6540	6430	6321	184
50	7327	7211	7094	6980	6865	192	50	6752	6640	6529	6418	6310	185
58 0	9.997319	7202	7085	6970	6855	193	58 0	9.996742	6629	6518	6407	6298	185
10	7310	7193	7076	6961	6845	193	10	6731	6619	6508	6396	6287	186
20	7301	7184	7066	6951	6835	194	20	6721	6608	6497	6385	6275	186
30	7293	7175	7057	6942	6825	194	30	6711	6597	6486	6374	6264	187
40	7284	7166	7048	6932	6815	195	40	6701	6587	6475	6362	6252	187
50	7276	7157	7039	6923	6805	195	50	6690	6576	6464	6351	6241	188
59 0	9.997267	7148	7029	6913	6795	196	59 0	9.996680	6566	6453	6340	6229	188
10	7259	7139	7020	6904	6785	196	10	6670	6555	6442	6329	6218	189
20	7250	7130	7011	6894	6775	197	20	6659	6544	6431	6318	6206	189
30	7241	7122	7002	6884	6766	198	30	6649	6534	6420	6307	6195	190
40	7233	7113	6992	6875	6756	198	40	6639	6523	6409	6295	6183	190
50	7224	7104	6983	6865	6746	199	50	6629	6513	6398	6284	6172	191
60 0	9.997216	7095	6974	6855	6736	199	60 0	9.996619	6502	6387	6273	6160	191
10	7207	7086	6965	6846	6726	200	10	6608	6492	6377	6262	6149	192
20	7199	7077	6955	6836	6716	201	20	6598	6481	6366	6251	6137	192
30	7190	7068	6946	6827	6706	201	30	6588	6471	6355	6239	6126	193
40	7182	7060	6937	6817	6696	202	40	6578	6460	6344	6228	6114	193
50	7173	7051	6928	6808	6686	202	50	6567	6449	6333	6217	6103	194
61 0	9.997164	7042	6918	6798	6676	203	61 0	9.996557	6439	6322	6206	6091	194
10	7156	7033	6909	6788	6666	204	10	6547	6428	6312	6195	6080	195
20	7147	7024	6900	6779	6657	205	20	6537	6418	6301	6184	6068	195
30	7139	7015	6891	6769	6647	205	30	6526	6407	6290	6172	6057	196
40	7130	7006	6882	6759	6637	206	40	6516	6397	6279	6161	6045	197
50	7122	6997	6872	6749	6627	206	50	6506	6386	6268	6150	6034	197
62 0	9.997113	6988	6863	6740	6617	207	62 0	9.996496	6376	6257	6139	6022	198

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	
	1	2	3	3	4	5	6	7	8	Sub.

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	
	1	2	3	4	6	7	8	9	10	Sub.

Sun's Alt.	5°	6°	7°	10°	15°	20°	30	40°	60°	90°
Corr. Sub.	14	11	9	7	6	8	10	12	16	19

Star's Alt.	5°	6°	7°	8	9	10°	15°	20°	25°	30°
Corr. Sub.	12	9	7	6	5	4	1	1	1	0

TABLE XXXI.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.		Moon's Apparent Altitude. 33°	34°	35°	36°	37°	Diff. to 100′
53′	0″	9.996544	6447	6351	6256	6162	159
	10	6533	6435	6338	6243	6149	159
	20	6521	6423	6326	6230	6136	160
	30	6509	6411	6314	6217	6123	161
	40	6497	6399	6301	6205	6110	161
	50	6485	6386	6289	6192	6097	162
54	0	9.996474	6374	6276	6179	6084	162
	10	6462	6362	6264	6167	6071	163
	20	6450	6350	6252	6154	6058	163
	30	6438	6338	6239	6141	6045	164
	40	6426	6326	6227	6128	6032	164
	50	6414	6314	6214	6116	6019	165
55	0	9.996403	6302	6202	6103	6005	165
	10	6391	6290	6189	6091	5992	166
	20	6379	6277	6177	6079	5979	166
	30	6367	6265	6165	6065	5966	167
	40	6355	6253	6152	6052	5953	167
	50	6344	6241	6140	6039	5940	168
56	0	9.996332	6229	6127	6027	5927	168
	10	6320	6217	6115	6014	5914	169
	20	6308	6205	6102	6001	5901	169
	30	6296	6193	6090	5989	5888	170
	40	6285	6180	6078	5976	5875	170
	50	6273	6168	6065	5963	5862	171
57	0	9.996261	6156	6053	5950	5849	171
	10	6249	6144	6040	5938	5836	172
	20	6237	6132	6028	5925	5823	172
	30	6226	6120	6015	5912	5810	173
	40	6214	6108	6002	5900	5797	173
	50	6202	6096	5991	5887	5784	174
58	0	9.996190	6084	5978	5874	5771	174
	10	6178	6071	5966	5861	5758	175
	20	6166	6059	5953	5849	5745	175
	30	6155	6047	5941	5836	5732	176
	40	6143	6035	5929	5823	5719	176
	50	6131	6023	5916	5811	5706	177
59	0	9.996119	6011	5904	5798	5693	177
	10	6107	5999	5891	5785	5680	178
	20	6096	5987	5879	5772	5667	178
	30	6084	5975	5866	5760	5654	179
	40	6072	5962	5854	5747	5641	179
	50	6060	5950	5842	5734	5628	180
60	0	9.996048	5938	5829	5721	5615	180
	10	6037	5926	5817	5708	5602	181
	20	6025	5914	5804	5695	5589	181
	30	6013	5902	5792	5683	5576	182
	40	6001	5890	5779	5671	5563	182
	50	5989	5878	5767	5658	5550	183
61	0	9.995978	5866	5755	5645	5537	183
	10	5966	5853	5742	5632	5524	184
	20	5954	5841	5730	5620	5511	184
	30	5942	5829	5717	5607	5498	185
	40	5930	5817	5705	5594	5485	186
	50	5919	5805	5693	5582	5472	187
62	0	9.995907	5793	5680	5569	5459	187

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	
	1	3	4	5	6	7	9	10	11	Sub.

Sun's Alt.	5°	6°	7°	10°	15°	20°	30°	40°	60°	90°
Corr. Sub.	14	11	9	7	6	8	10	12	16	19

Moon's Hor. Par.		Moon's Apparent Altitude. 38°	39°	40°	41°	42°	Diff. to 100′
53′	0″	9.996069	5977	5887	5798	5711	149
	10	6056	5964	5873	5784	5696	150
	20	6042	5950	5859	5770	5682	150
	30	6029	5936	5845	5756	5667	151
	40	6016	5923	5831	5741	5653	152
	50	6002	5909	5818	5727	5638	152
54	0	9.995989	5896	5804	5713	5624	153
	10	5976	5882	5790	5699	5609	153
	20	5963	5868	5776	5685	5595	154
	30	5949	5855	5762	5671	5580	154
	40	5936	5841	5748	5656	5566	155
	50	5923	5828	5734	5642	5552	155
55	0	9.995909	5814	5720	5628	5537	156
	10	5896	5801	5707	5614	5523	156
	20	5883	5787	5693	5600	5508	157
	30	5869	5773	5679	5586	5494	157
	40	5856	5760	5665	5571	5479	158
	50	5843	5746	5651	5557	5465	158
56	0	9.995829	5733	5637	5543	5451	158
	10	5816	5719	5623	5529	5436	159
	20	5803	5705	5610	5515	5422	159
	30	5790	5692	5596	5501	5407	160
	40	5776	5678	5582	5486	5393	160
	50	5763	5665	5568	5472	5378	161
57	0	9.995750	5651	5554	5458	5364	161
	10	5736	5637	5540	5444	5350	162
	20	5723	5624	5526	5430	5335	162
	30	5710	5610	5512	5416	5321	162
	40	5696	5597	5498	5402	5306	163
	50	5683	5583	5484	5387	5292	163
58	0	9.995670	5569	5471	5373	5277	164
	10	5656	5556	5457	5359	5263	164
	20	5643	5542	5443	5345	5249	165
	30	5630	5529	5429	5331	5234	165
	40	5617	5515	5415	5317	5220	166
	50	5603	5501	5401	5302	5205	166
59	0	9.995590	5488	5387	5288	5191	167
	10	5576	5474	5373	5274	5176	167
	20	5563	5461	5360	5260	5162	167
	30	5550	5447	5346	5246	5147	168
	40	5537	5433	5332	5232	5133	168
	50	5523	5420	5318	5217	5119	168
60	0	9.995510	5406	5304	5203	5104	169
	10	5497	5393	5290	5189	5090	169
	20	5483	5379	5276	5175	5075	170
	30	5470	5365	5262	5161	5061	170
	40	5457	5352	5249	5147	5046	171
	50	5444	5338	5235	5132	5032	171
61	0	9.995430	5325	5221	5118	5018	172
	10	5417	5311	5207	5104	5003	172
	20	5404	5297	5193	5090	4989	173
	30	5390	5284	5179	5076	4974	173
	40	5377	5270	5165	5062	4960	174
	50	5364	5257	5151	5048	4945	174
62	0	9.995350	5243	5137	5033	4931	175

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	
	1	3	4	6	7	8	10	11	13	Sub.

Star's Alt.	5°	6°	7°	8°	9°	10°	15°	20°	25°	30°
Corr. Sub.	12	9	7	6	5	4	1	1	1	0

TABLE XXXI.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	Moon's Apparent Altitude.					Diff. to 100′
	43°	44°	45°	46°	47°	
53′ 0″	9.995624	5539	5456	5374	5294	138
10	5610	5525	5441	5359	5278	138
20	5595	5510	5426	5343	5262	138
30	5580	5495	5410	5328	5246	139
40	5565	5480	5395	5312	5231	139
50	5551	5465	5380	5297	5215	139
54 0	9.995536	5450	5365	5281	5199	140
10	5521	5435	5350	5266	5183	140
20	5507	5420	5334	5250	5168	141
30	5492	5405	5319	5235	5152	141
40	5477	5390	5304	5219	5136	142
50	5463	5375	5289	5204	5120	142
55 0	9.995448	5360	5273	5188	5105	143
10	5433	5345	5258	5173	5089	143
20	5418	5330	5243	5157	5073	144
30	5404	5315	5228	5142	5057	144
40	5389	5300	5212	5126	5042	145
50	5374	5285	5197	5111	5026	145
56 0	9.995360	5270	5182	5095	5010	146
10	5345	5255	5167	5080	4994	146
20	5330	5240	5151	5064	4979	147
30	5315	5225	5136	5049	4963	147
40	5301	5210	5121	5033	4947	147
50	5286	5195	5106	5018	4932	148
57 0	9.995271	5180	5091	5002	4916	148
10	5257	5165	5075	4987	4900	149
20	5242	5150	5060	4971	4884	149
30	5227	5135	5045	4956	4869	150
40	5213	5120	5030	4940	4853	150
50	5198	5105	5014	4925	4837	151
58 0	9.995183	5090	4999	4909	4821	151
10	5168	5075	4984	4894	4806	152
20	5154	5060	4969	4878	4790	152
30	5139	5045	4953	4863	4774	152
40	5124	5030	4938	4847	4758	153
50	5109	5015	4923	4832	4743	153
59 0	9.995095	5000	4908	4816	4727	153
10	5080	4986	4892	4800	4711	154
20	5065	4971	4877	4785	4695	154
30	5051	4956	4862	4770	4680	155
40	5036	4941	4847	4754	4664	155
50	5021	4926	4831	4739	4648	156
60 0	9.995007	4911	4816	4723	4632	156
10	4992	4896	4801	4708	4617	157
20	4977	4881	4786	4692	4601	157
30	4963	4866	4771	4676	4585	157
40	4948	4851	4755	4661	4569	158
50	4933	4836	4740	4646	4554	158
61 0	9.994918	4821	4725	4630	4538	158
10	4904	4806	4710	4615	4522	159
20	4889	4791	4694	4599	4506	159
30	4874	4776	4679	4584	4491	160
40	4860	4761	4664	4568	4475	160
50	4845	4746	4649	4553	4459	161
62 0	9.994830	4731	4633	4537	4443	161

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	2	3	4	6	7	9	10	12	14	

Sun's Alt.	5°	6°	7°	10°	15°	20°	30°	40°	60°	90°
Corr. Sub.	14	11	9	7	6	8	10	12	16	19

Moon's Hor. Par.	Moon's Apparent Altitude.					Diff. to 100′
	48°	49°	50°	51°	52°	
53′ 0″	9.995215	5137	5061	4987	4914	126
10	5199	5121	5045	4970	4897	126
20	5183	5105	5028	4953	4880	127
30	5167	5088	5012	4937	4863	127
40	5151	5072	4995	4920	4846	127
50	5135	5056	4979	4903	4829	128
54 0	9.995119	5040	4962	4886	4812	128
10	5103	5023	4946	4870	4795	128
20	5087	5007	4929	4853	4778	129
30	5071	4991	4913	4836	4761	129
40	5055	4975	4896	4820	4745	130
50	5039	4958	4880	4803	4728	130
55 0	9.995023	4942	4863	4786	4711	131
10	5007	4926	4847	4769	4694	131
20	4991	4910	4830	4753	4677	131
30	4975	4894	4814	4736	4660	132
40	4959	4877	4797	4719	4643	132
50	4943	4861	4781	4703	4626	132
56 0	9.994927	4845	4764	4686	4609	133
10	4911	4829	4748	4669	4592	133
20	4895	4812	4731	4652	4575	133
30	4879	4796	4715	4636	4558	134
40	4863	4780	4698	4619	4541	134
50	4847	4764	4682	4602	4524	135
57 0	9.994831	4747	4665	4586	4507	135
10	4815	4731	4649	4569	4490	136
20	4799	4715	4633	4552	4474	136
30	4783	4699	4616	4535	4457	136
40	4767	4682	4600	4519	4440	137
50	4751	4666	4583	4502	4423	137
58 0	9.994735	4650	4567	4485	4406	137
10	4719	4634	4550	4469	4389	138
20	4703	4617	4534	4452	4372	138
30	4687	4601	4517	4435	4355	138
40	4671	4585	4501	4418	4338	139
50	4655	4569	4484	4402	4321	139
59 0	9.994639	4552	4468	4385	4304	140
10	4622	4536	4451	4368	4287	140
20	4607	4520	4435	4352	4270	141
30	4591	4504	4418	4335	4253	141
40	4575	4488	4402	4318	4236	142
50	4559	4471	4385	4301	4220	142
60 0	9.994543	4455	4369	4285	4203	142
10	4527	4439	4352	4268	4186	143
20	4511	4423	4336	4251	4169	143
30	4495	4406	4319	4235	4152	143
40	4479	4390	4303	4218	4135	144
50	4463	4374	4286	4201	4118	144
61 0	9.994447	4358	4270	4184	4101	145
10	4431	4341	4254	4168	4084	145
20	4415	4325	4237	4151	4067	145
30	4399	4309	4221	4134	4050	146
40	4383	4293	4204	4118	4033	146
50	4367	4276	4188	4101	4016	147
62 0	9.994351	4260	4171	4084	3999	147

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	2	3	5	7	8	10	12	13	15	

Star's Alt.	5°	6°	7°	8°	9°	10°	15°	20°	25°	30°
Corr. Sub.	12	9	7	6	5	4	2	1	1	0

TABLE XXXI.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	Moon's Apparent Altitude.					Diff. to 100′
	53°	54°	55°	56°	57°	
53′ 0″	9.994843	4773	4705	4639	4575	112
10	4825	4756	4687	4621	4557	112
20	4808	4738	4670	4603	4539	112
30	4791	4721	4652	4586	4521	113
40	4774	4703	4635	4568	4503	113
50	4757	4686	4617	4550	4485	113
54 0	9.994740	4669	4600	4532	4467	114
10	4723	4651	4582	4514	4449	114
20	4705	4634	4564	4497	4431	114
30	4688	4617	4547	4479	4413	115
40	4671	4599	4529	4461	4395	115
50	4654	4582	4512	4443	4377	115
55 0	9.994637	4564	4494	4426	4359	116
10	4620	4547	4476	4408	4341	116
20	4602	4530	4459	4390	4323	117
30	4585	4512	4441	4372	4305	117
40	4568	4495	4424	4354	4287	117
50	4551	4478	4406	4336	4269	118
56 0	9.994534	4460	4389	4319	4251	118
10	4517	4443	4371	4301	4233	118
20	4499	4426	4353	4283	4215	119
30	4482	4408	4336	4265	4197	119
40	4465	4391	4318	4247	4179	120
50	4448	4373	4301	4230	4161	120
57 0	9.994431	4356	4283	4212	4143	121
10	4414	4339	4265	4194	4125	121
20	4397	4321	4248	4176	4107	121
30	4379	4304	4230	4158	4089	122
40	4362	4287	4213	4141	4071	122
50	4345	4269	4195	4123	4053	122
58 0	9.994328	4252	4178	4105	4035	123
10	4311	4234	4160	4087	4017	123
20	4294	4217	4142	4069	3999	123
30	4276	4200	4125	4052	3981	124
40	4259	4182	4107	4034	3963	124
50	4242	4165	4090	4016	3945	124
59 0	9.994225	4148	4072	3998	3926	125
10	4208	4130	4054	3981	3908	125
20	4191	4113	4037	3963	3890	125
30	4174	4096	4019	3945	3872	126
40	4157	4078	4002	3927	3854	126
50	4139	4061	3984	3909	3836	127
60 0	9.994122	4043	3967	3892	3818	127
10	4105	4026	3949	3874	3800	127
20	4088	4009	3931	3856	3782	128
30	4071	3991	3914	3838	3764	128
40	4054	3974	3896	3820	3746	128
50	4036	3957	3879	3803	3728	129
61 0	9.994019	3939	3861	3785	3710	129
10	4002	3922	3843	3766	3692	129
20	3985	3904	3826	3749	3674	130
30	3968	3887	3808	3731	3656	130
40	3951	3870	3791	3714	3638	130
50	3933	3852	3773	3696	3620	131
62 0	9.993916	3835	3755	3678	3602	131

P. parts to sec. of par. { 1″ 2″ 3″ 4″ 5″ 6″ 7″ 8″ 9″ / 2 3 5 7 9 11 13 14 16 } Sub.

Moon's Hor. Par.	Moon's Apparent Altitude.					Diff. to 100′
	58°	59°	60°	61°	62°	
53′ 0″	9.994512	4451	4391	4334	4278	96
10	4494	4432	4373	4315	4259	97
20	4475	4414	4354	4296	4240	97
30	4457	4396	4336	4278	4221	97
40	4439	4377	4317	4259	4202	98
50	4421	4359	4299	4240	4183	98
54 0	9.994403	4340	4280	4221	4164	98
10	4384	4322	4261	4203	4146	99
20	4366	4304	4243	4184	4127	99
30	4348	4285	4224	4165	4108	99
40	4330	4267	4206	4146	4089	100
50	4311	4248	4187	4128	4070	100
55 0	9.994293	4230	4168	4109	4051	101
10	4275	4212	4150	4090	4032	101
20	4257	4193	4131	4071	4013	101
30	4239	4175	4113	4053	3994	102
40	4220	4157	4094	4034	3975	102
50	4202	4138	4076	4015	3956	102
56 0	9.994184	4120	4057	3996	3937	103
10	4166	4101	4038	3977	3918	103
20	4148	4083	4020	3959	3899	103
30	4129	4064	4001	3940	3881	104
40	4111	4046	3983	3921	3862	104
50	4093	4028	3964	3902	3843	104
57 0	9.994075	4009	3945	3883	3824	104
10	4057	3991	3927	3865	3805	105
20	4038	3972	3908	3846	3786	105
30	4020	3954	3890	3827	3767	105
40	4002	3936	3871	3809	3748	106
50	3984	3917	3853	3790	3729	106
58 0	9.993966	3899	3834	3771	3710	106
10	3947	3880	3815	3752	3691	107
20	3929	3862	3797	3734	3672	107
30	3911	3844	3778	3715	3653	107
40	3893	3825	3759	3696	3634	107
50	3875	3807	3741	3677	3615	108
59 0	9.993856	3788	3722	3659	3596	108
10	3838	3770	3704	3640	3577	108
20	3820	3752	3685	3621	3558	109
30	3802	3733	3667	3602	3540	109
40	3784	3715	3648	3583	3520	109
50	3765	3696	3629	3565	3502	110
60 0	9.993747	3678	3611	3546	3483	110
10	3729	3660	3592	3527	3464	110
20	3711	3641	3574	3508	3445	111
30	3692	3623	3555	3489	3426	111
40	3674	3604	3536	3471	3407	111
50	3656	3586	3518	3452	3388	112
61 0	9.993638	3568	3500	3433	3369	112
10	3620	3549	3481	3414	3350	112
20	3601	3531	3462	3396	3331	113
30	3583	3512	3444	3377	3312	113
40	3565	3494	3425	3358	3293	113
50	3547	3476	3406	3339	3274	114
62 0	9.993529	3457	3388	3320	3255	114

P. parts to sec. of par. { 1″ 2″ 3″ 4″ 5″ 6″ 7″ 8″ 9″ / 2 4 6 7 9 11 13 15 17 } Sub.

Sun's Alt.	5°	6°	7°	10°	15°	20°	30°	40°	60°	90°
Corr. Sub.	14	11	9	7	6	8	10	12	16	19

Star's Alt.	5°	6°	7°	8°	9°	10°	15°	20°	25°	30°
Corr. Sub.	12	9	7	6	5	4	1	1	1	0

TABLE XXXI.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	Moon's Apparent Altitude.					Diff. to 100′
	63°	64	65°	66°	67°	
53′ 0″	9.994224	4172	4122	4073	4027	82
10	4205	4153	4102	4053	4007	82
20	4186	4133	4083	4034	3987	83
30	4167	4114	4063	4014	3967	83
40	4148	4095	4044	3995	3948	83
50	4128	4076	4024	3975	3928	84
54 0	9.994109	4056	4005	3956	3908	84
10	4090	4037	3986	3936	3888	84
20	4071	4018	3966	3916	3869	85
30	4052	3998	3947	3897	3849	85
40	4033	3979	3927	3877	3829	85
50	4014	3960	3908	3858	3809	86
55 0	9.993995	3941	3888	3838	3790	86
10	3976	3921	3869	3818	3770	86
20	3956	3902	3850	3799	3750	86
30	3937	3883	3830	3779	3731	87
40	3918	3863	3811	3760	3711	87
50	3899	3844	3791	3740	3691	87
56 0	9.993880	3825	3772	3721	3671	87
10	3861	3806	3752	3701	3652	88
20	3842	3786	3733	3681	3632	88
30	3823	3767	3713	3662	3612	88
40	3804	3748	3694	3642	3592	88
50	3785	3729	3675	3623	3573	89
57 0	9.993765	3709	3655	3603	3553	89
10	3746	3690	3636	3583	3533	89
20	3727	3671	3616	3564	3513	89
30	3708	3651	3597	3544	3494	90
40	3689	3632	3577	3525	3474	90
50	3670	3613	3558	3505	3454	90
58 0	9.993651	3594	3539	3486	3435	91
10	3632	3574	3519	3466	3415	91
20	3612	3555	3500	3446	3395	91
30	3593	3536	3480	3427	3375	91
40	3574	3516	3461	3407	3356	92
50	3557	3497	3441	3388	3336	92
59 0	9.993536	3478	3422	3368	3316	92
10	3519	3459	3403	3348	3296	92
20	3498	3439	3383	3329	3277	93
30	3479	3420	3364	3309	3257	93
40	3460	3401	3344	3290	3237	93
50	3441	3382	3325	3270	3217	93
60 0	9.993421	3362	3305	3251	3198	94
10	3402	3343	3286	3231	3178	94
20	3383	3324	3267	3211	3158	94
30	3364	3304	3247	3192	3139	94
40	3345	3285	3228	3172	3119	95
50	3326	3266	3208	3153	3099	95
61 0	9.993307	3247	3189	3133	3079	95
10	3288	3227	3169	3113	3060	95
20	3269	3208	3150	3094	3040	96
30	3249	3189	3130	3074	3020	96
40	3230	3170	3111	3055	3000	96
50	3211	3150	3092	3035	2981	97
62 0	9.993192	3131	3072	3015	2961	97

P. parts to sec. of par. { 1″ 2″ 3″ 4″ 5″ 6″ 7″ 8″ 9″ / 2 4 6 8 10 12 14 16 18 } Sub.

Moon's Hor. Par.	Moon's Apparent Altitude.					Diff. to 100′
	68°	69°	70°	71°	72	
53′ 0″	9.993982	3939	3898	3859	3822	67
10	3962	3919	3878	3839	3802	67
20	3942	3899	3858	3818	3781	67
30	3922	3879	3838	3798	3761	67
40	3902	3859	3818	3778	3740	67
50	3883	3839	3797	3758	3720	67
54 0	9.993863	3819	3777	3737	3700	68
10	3843	3799	3757	3717	3679	68
20	3823	3779	3737	3697	3659	68
30	3803	3759	3717	3677	3639	68
40	3783	3739	3697	3656	3618	68
50	3763	3719	3677	3636	3598	68
55 0	9.993743	3699	3656	3616	3577	69
10	3723	3679	3636	3596	3557	69
20	3704	3659	3616	3575	3537	69
30	3684	3639	3596	3555	3516	69
40	3664	3619	3576	3535	3496	69
50	3644	3599	3556	3515	3476	70
56 0	9.993624	3579	3536	3494	3455	70
10	3604	3559	3515	3474	3435	70
20	3584	3539	3495	3454	3414	70
30	3564	3519	3475	3433	3394	70
40	3545	3499	3455	3413	3374	71
50	3525	3479	3435	3393	3353	71
57 0	9.993505	3459	3415	3373	3333	71
10	3485	3439	3395	3352	3312	71
20	3465	3419	3374	3332	3292	71
30	3445	3399	3354	3312	3272	72
40	3425	3379	3334	3292	3251	72
50	3405	3359	3314	3271	3231	72
58 0	9.993386	3339	3294	3251	3211	72
10	3366	3319	3274	3231	3190	72
20	3346	3299	3254	3211	3170	73
30	3326	3279	3234	3190	3149	73
40	3306	3259	3213	3170	3129	73
50	3286	3239	3193	3150	3109	73
59 0	9.993266	3219	3173	3130	3088	73
10	3246	3199	3153	3109	3068	74
20	3227	3179	3133	3089	3048	74
30	3207	3159	3113	3069	3027	74
40	3187	3139	3092	3049	3007	74
50	3167	3119	3072	3028	2986	75
60 0	9.993147	3099	3052	3008	2966	75
10	3127	3079	3032	2988	2946	75
20	3107	3058	3012	2968	2925	75
30	3087	3038	2992	2947	2905	76
40	3068	3018	2972	2927	2885	76
50	3048	2998	2951	2907	2864	76
61 0	9.993028	2978	2931	2887	2844	76
10	3008	2958	2911	2866	2823	76
20	2988	2938	2891	2846	2803	77
30	2968	2918	2871	2826	2782	77
40	2948	2898	2851	2806	2762	77
50	2928	2878	2831	2785	2742	77
62 0	9.992909	2858	2810	2765	2722	77

P. parts to sec. of par. { 1″ 2″ 3″ 4″ 5″ 6″ 7″ 8″ 9″ / 2 4 6 8 10 12 14 16 18 } Sub.

Sun's Alt.	5°	6°	7°	10°	15°	20°	30°	40°	60°	90°
Corr. Sub.	14	11	9	7	6	8	10	12	16	19

Star's Alt.	5°	6°	7°	8°	9°	10°	15°	20°	25°	30°
Corr. Sub.	12	9	7	6	5	4	1	1	1	0

TABLE XXXI.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	Moon's Apparent Altitude.					Diff. to 100′
	73°	74°	75°	76°	77°	
53′ 0″	9.993787	3754	3722	3693	3666	52
10	3766	3733	3702	3672	3645	52
20	3746	3712	3681	3651	3624	52
30	3725	3692	3660	3631	3603	52
40	3705	3671	3639	3610	3582	52
50	3684	3651	3619	3589	3561	52
54 0	9.993664	3630	3598	3568	3541	52
10	3643	3609	3578	3548	3520	52
20	3623	3589	3557	3527	3499	52
30	3602	3568	3536	3506	3478	53
40	3582	3548	3515	3485	3457	53
50	3561	3527	3495	3464	3436	53
55 0	9.993541	3506	3474	3444	3415	53
10	3520	3486	3454	3423	3394	53
20	3500	3465	3433	3402	3374	53
30	3479	3445	3413	3381	3353	53
40	3459	3424	3392	3361	3332	54
50	3438	3403	3371	3340	3311	54
56 0	9.993418	3383	3350	3319	3290	54
10	3398	3362	3330	3299	3269	54
20	3377	3342	3309	3278	3248	54
30	3357	3321	3288	3257	3227	54
40	3336	3300	3267	3236	3206	54
50	3316	3279	3246	3215	3186	55
57 0	9.993295	3259	3226	3194	3165	55
10	3275	3238	3205	3174	3144	55
20	3254	3218	3184	3153	3123	55
30	3234	3197	3164	3132	3102	55
40	3213	3177	3143	3111	3081	55
50	3193	3156	3122	3090	3061	56
58 0	9.993172	3136	3102	3070	3040	56
10	3152	3115	3082	3049	3019	56
20	3131	3095	3061	3028	2998	56
30	3110	3074	3040	3007	2977	56
40	3090	3053	3019	2986	2956	56
50	3070	3033	2998	2966	2935	56
59 0	9.993049	3012	2977	2945	2914	57
10	3029	2992	2957	2924	2894	57
20	3008	2971	2936	2903	2873	57
30	2988	2950	2915	2883	2852	57
40	2967	2930	2895	2862	2831	57
50	2947	2909	2874	2841	2810	57
60 0	9.992926	2889	2853	2820	2789	58
10	2906	2868	2833	2800	2768	58
20	2885	2847	2812	2779	2747	58
30	2865	2827	2791	2758	2727	58
40	2844	2806	2771	2738	2706	58
50	2824	2786	2750	2717	2685	58
61 0	9.992803	2765	2729	2695	2664	58
10	2783	2744	2709	2674	2643	59
20	2762	2724	2688	2654	2622	59
30	2742	2703	2667	2633	2601	59
40	2721	2683	2646	2612	2581	59
50	2701	2662	2626	2591	2560	59
62 0	9.992680	2641	2605	2571	2539	59

P. parts to	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
sec. of par.	2	4	6	8	11	13	15	17	19	

Sun's Alt.	5°	6°	7°	10°	15°	20°	30°	40°	60°	90°
Corr. Sub.	14	11	9	7	6	8	10	12	16	19

Moon's Hor. Par.	Moon's Apparent Altitude.					Diff. to 100′
	78°	79°	80°	81°	82°	
53′ 0″	9.993640	3617	3596	3577	3559	33
10	3620	3596	3575	3555	3538	33
20	3599	3575	3554	3534	3517	33
30	3578	3554	3533	3513	3496	34
40	3557	3533	3512	3492	3474	34
50	3536	3512	3490	3471	3453	34
54 0	9.993515	3491	3469	3450	3432	34
10	3494	3470	3448	3428	3411	34
20	3473	3449	3427	3407	3390	34
30	3452	3428	3406	3386	3368	34
40	3431	3407	3385	3365	3347	35
50	3410	3386	3364	3344	3326	35
55 0	9.993389	3365	3342	3323	3305	35
10	3368	3344	3321	3302	3284	35
20	3347	3323	3300	3280	3262	35
30	3326	3302	3279	3259	3241	35
40	3305	3281	3258	3238	3220	35
50	3284	3260	3237	3217	3199	35
56 0	9.993263	3239	3216	3196	3178	36
10	3242	3218	3195	3175	3156	36
20	3222	3197	3174	3153	3135	36
30	3201	3176	3153	3132	3114	36
40	3180	3155	3132	3111	3093	36
50	3159	3134	3111	3090	3072	36
57 0	9.993138	3113	3090	3069	3050	36
10	3117	3092	3069	3048	3029	36
20	3096	3071	3048	3027	3008	36
30	3075	3050	3026	3005	2987	36
40	3054	3029	3005	2984	2965	37
50	3033	3008	2984	2963	2944	37
58 0	9.993012	2987	2963	2942	2923	37
10	2991	2966	2942	2921	2902	37
20	2970	2945	2921	2900	2881	37
30	2949	2924	2900	2879	2859	37
40	2928	2903	2879	2857	2838	37
50	2907	2882	2858	2836	2817	37
59 0	9.992886	2861	2837	2815	2796	37
10	2865	2840	2816	2794	2775	37
20	2844	2818	2795	2773	2753	37
30	2824	2797	2773	2752	2732	37
40	2803	2776	2752	2730	2711	38
50	2782	2755	2731	2709	2690	38
60 0	9.992761	2734	2710	2688	2669	38
10	2740	2713	2689	2667	2647	38
20	2719	2692	2668	2646	2626	38
30	2698	2671	2647	2625	2605	38
40	2677	2650	2626	2604	2584	38
50	2656	2629	2605	2582	2563	38
61 0	9.992635	2608	2584	2561	2542	38
10	2614	2587	2563	2540	2520	38
20	2593	2566	2541	2519	2499	38
30	2572	2545	2520	2498	2478	38
40	2551	2524	2499	2477	2457	38
50	2530	2503	2478	2456	2435	39
62 0	9.992509	2482	2457	2434	2414	39

P. parts to	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
sec. of par.	2	4	6	8	11	13	15	17	19	

Star's Alt.	5°	6°	7°	8°	9°	10°	15°	20°	25°	30°
Corr. Sub.	12	9	7	6	5	4	1	1	1	0

TABLE XXXI.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	Moon's Apparent Alt.				Diff. to 100′	Moon's Hor. Par.	Moon's App. Alt.		
	83°	84°	85°	86°			87°	88°	89°
53′ 0″	9.993544	3531	3519	3510	18	53′ 0″	9.993503	3498	3495
10	3523	3510	3498	3489	18	10	3482	3477	3474
20	3502	3488	3477	3467	18	20	3460	3455	3452
30	3480	3467	3456	3446	18	30	3439	3434	3431
40	3459	3446	3434	3425	18	40	3417	3413	3409
50	3438	3424	3413	3403	18	50	3396	3391	3388
54 0	9.993417	3403	3392	3382	18	54 0	9.993375	3370	3367
10	3395	3382	3370	3361	18	10	3353	3348	3345
20	3374	3360	3349	3339	18	20	3332	3327	3324
30	3353	3339	3328	3318	18	30	3311	3306	3302
40	3332	3318	3306	3297	18	40	3289	3284	3281
50	3310	3297	3285	3275	18	50	3268	3263	3260
55 0	9.993289	3275	3264	3254	18	55 0	9.993247	3241	3238
10	3268	3254	3242	3233	18	10	3225	3220	3217
20	3247	3233	3221	3211	18	20	3204	3199	3195
30	3225	3211	3200	3190	18	30	3182	3177	3174
40	3204	3190	3178	3169	18	40	3161	3156	3153
50	3183	3169	3157	3147	18	50	3140	3134	3131
56 0	9.993162	3148	3136	3126	19	56 0	9.993118	3113	3110
10	3140	3126	3114	3105	19	10	3097	3092	3088
20	3119	3105	3093	3084	19	20	3075	3070	3067
30	3098	3084	3072	3062	19	30	3054	3049	3046
40	3077	3062	3050	3040	19	40	3033	3027	3024
50	3055	3041	3029	3019	19	50	3012	3006	3003
57 0	9.993034	3020	3008	2998	19	57 0	9.992990	2985	2981
10	3013	2999	2986	2976	19	10	2969	2963	2960
20	2992	2977	2965	2955	19	20	2947	2942	2939
30	2970	2956	2944	2933	19	30	2926	2920	2917
40	2949	2935	2922	2912	19	40	2905	2899	2896
50	2928	2913	2901	2891	19	50	2883	2878	2874
58 0	9.992907	2892	2880	2870	19	58 0	9.992862	2856	2853
10	2885	2871	2858	2849	19	10	2840	2835	2832
20	2864	2850	2837	2827	19	20	2819	2813	2810
30	2843	2828	2816	2806	19	30	2798	2792	2789
40	2822	2807	2794	2784	19	40	2776	2771	2767
50	2800	2786	2773	2763	19	50	2755	2749	2746
59 0	9.992779	2764	2752	2742	19	59 0	9.992734	2728	2725
10	2758	2743	2730	2720	19	10	2712	2706	2703
20	2737	2722	2709	2699	19	20	2691	2685	2682
30	2715	2701	2688	2677	19	30	2669	2664	2660
40	2694	2679	2667	2656	19	40	2648	2642	2639
50	2673	2658	2645	2635	19	50	2627	2621	2618
60 0	9.992652	2637	2624	2613	19	60 0	9.992605	2600	2596
10	2630	2615	2603	2592	19	10	2584	2578	2575
20	2609	2594	2581	2571	19	20	2563	2557	2553
30	2588	2573	2560	2549	19	30	2541	2535	2532
40	2567	2552	2539	2528	19	40	2520	2514	2511
50	2545	2530	2517	2507	19	50	2499	2493	2489
61 0	9.992524	2509	2496	2485	19	61 0	9.992477	2471	2468
10	2503	2488	2475	2464	19	10	2456	2450	2446
20	2481	2466	2453	2443	19	20	2434	2428	2425
30	2460	2445	2432	2421	19	30	2413	2407	2404
40	2439	2424	2411	2400	19	40	2392	2386	2382
50	2418	2402	2389	2379	19	50	2370	2364	2361
62 0	9.992396	2381	2368	2357	19	62 0	9.992349	2343	2339

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	
	2	4	6	9	11	13	15	17	19	Sub.

Sun's Alt.	5°	6°	7°	10°	15°	20°	30°	40°	60°	90°
Corr. Sub.	14	11	9	7	6	8	10	12	16	19

Star's Alt.	5°	6°	7°	8°	9°	10°	15°	20°	25°	30°
Corr. Sub.	12	9	7	6	5	4	1	1	1	0

TABLE XXXII.

To correct the Logarithmic diff. when the Sun is observed.

App. Alt. Sun.	Cor. Sub.	App. Alt. Sun.	Cor. Sub.
°		°	
3	28	44	13
4	19	46	14
5	14	48	14
6	11	49	14
7	9	50	15
8	8	52	15
9	7	54	15
10	7	55	16
12	6	56	16
14	6	58	16
16	7	60	16
18	7	62	16
20	8	63	17
21	8	64	17
22	8	66	17
24	8	68	17
25	8	69	18
26	9	70	18
28	9	72	18
29	10	74	18
30	10	76	18
32	10	78	18
33	11	79	18
34	11	80	18
36	11	81	18
37	12	82	18
38	12	84	19
40	12	86	19
41	13	88	19
42	13	90	19

TABLE XXXIII.

To correct the Logarithmic diff. when a Star is observed.

App. Alt. Star.	Cor. Sub.	App. Alt. Star.	Cor. Sub.
°		°	
3	27	23	1
4	19	24	1
5	12	25	1
6	9	26	1
7	7	27	1
8	6	28	1
9	5	29	1
10	4	30	0
11	3	31	0
12	3	32	0
13	2	33	0
14	2	34	0
15	1	35	0
16	1	36	0
17	1	37	0
18	1	38	0
19	1	39	0
20	1	40	0
21	1	to	
22	1	90	0

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 0° 0′	h. m. 0° 1′	h. m. 0° 2′	h. m. 0° 3′	h. m. 0° 4′	h. m. 0° 5′	h. m. 0° 6′	h. m. 0° 7′	h. m. 0° 8′	s. ″
0		2.2553	1.9542	1.7782	1.6532	1.5563	1.4771	1.4102	1.3522	0
1	4.0334	2.2481	1.9506	1.7757	1.6514	1.5549	1.4759	1.4091	1.3513	1
2	3.7324	2.2410	1.9471	1.7734	1.6496	1.5534	1.4747	1.4081	1.3504	2
3	3.5563	2.2341	1.9435	1.7710	1.6478	1.5520	1.4735	1.4071	1.3495	3
4	3.4314	2.2272	1.9400	1.7686	1.6460	1.5506	1.4723	1.4061	1.3486	4
5	3.3345	2.2205	1.9365	1.7663	1.6443	1.5491	1.4711	1.4050	1.3477	5
6	3.2553	2.2139	1.9331	1.7639	1.6425	1.5477	1.4699	1.4040	1.3468	6
7	3.1883	2.2073	1.9296	1.7616	1.6407	1.5463	1.4688	1.4030	1.3459	7
8	3.1303	2.2009	1.9262	1.7593	1.6390	1.5449	1.4676	1.4020	1.3450	8
9	3.0792	2.1946	1.9228	1.7570	1.6372	1.5435	1.4664	1.4010	1.3441	9
10	3.0334	2.1883	1.9195	1.7547	1.6355	1.5421	1.4652	1.4000	1.3432	10
11	2.9920	2.1822	1.9162	1.7524	1.6338	1.5407	1.4640	1.3989	1.3423	11
12	2.9542	2.1761	1.9128	1.7501	1.6320	1.5393	1.4629	1.3979	1.3415	12
13	2.9195	2.1701	1.9096	1.7479	1.6303	1.5379	1.4617	1.3969	1.3406	13
14	2.8873	2.1642	1.9063	1.7456	1.6286	1.5365	1.4606	1.3959	1.3397	14
15	2.8573	2.1584	1.9031	1.7434	1.6269	1.5351	1.4594	1.3949	1.3388	15
16	2.8293	2.1526	1.8999	1.7412	1.6252	1.5337	1.4582	1.3939	1.3379	16
17	2.8030	2.1469	1.8967	1.7390	1.6235	1.5324	1.4571	1.3929	1.3371	17
18	2.7782	2.1413	1.8935	1.7368	1.6218	1.5310	1.4559	1.3919	1.3362	18
19	2.7547	2.1358	1.8904	1.7346	1.6201	1.5296	1.4548	1.3910	1.3353	19
20	2.7324	2.1303	1.8873	1.7324	1.6185	1.5283	1.4536	1.3900	1.3345	20
21	2.7112	2.1249	1.8842	1.7302	1.6168	1.5269	1.4525	1.3890	1.3336	21
22	2.6910	2.1196	1.8811	1.7281	1.6151	1.5256	1.4514	1.3880	1.3327	22
23	2.6717	2.1143	1.8781	1.7259	1.6135	1.5242	1.4502	1.3870	1.3319	23
24	2.6532	2.1091	1.8751	1.7238	1.6118	1.5229	1.4491	1.3860	1.3310	24
25	2.6355	2.1040	1.8721	1.7217	1.6102	1.5215	1.4480	1.3851	1.3301	25
26	2.6185	2.0989	1.8691	1.7196	1.6085	1.5202	1.4468	1.3841	1.3293	26
27	2.6021	2.0939	1.8661	1.7175	1.6069	1.5189	1.4457	1.3831	1.3284	27
28	2.5863	2.0889	1.8632	1.7154	1.6053	1.5175	1.4446	1.3821	1.3276	28
29	2.5710	2.0840	1.8602	1.7133	1.6037	1.5162	1.4435	1.3812	1.3267	29
30	2.5563	2.0792	1.8573	1.7112	1.6021	1.5149	1.4424	1.3802	1.3259	30
31	2.5421	2.0744	1.8544	1.7091	1.6005	1.5136	1.4412	1.3792	1.3250	31
32	2.5283	2.0696	1.8516	1.7071	1.5989	1.5123	1.4401	1.3783	1.3242	32
33	2.5149	2.0649	1.8487	1.7050	1.5973	1.5110	1.4390	1.3773	1.3233	33
34	2.5019	2.0603	1.8459	1.7030	1.5957	1.5097	1.4379	1.3764	1.3225	34
35	2.4894	2.0557	1.8431	1.7010	1.5941	1.5084	1.4368	1.3754	1.3216	35
36	2.4771	2.0512	1.8403	1.6990	1.5925	1.5071	1.4357	1.3745	1.3208	36
37	2.4652	2.0467	1.8375	1.6970	1.5909	1.5058	1.4346	1.3735	1.3199	37
38	2.4536	2.0422	1.8348	1.6950	1.5894	1.5045	1.4335	1.3726	1.3191	38
39	2.4424	2.0378	1.8320	1.6930	1.5878	1.5032	1.4325	1.3716	1.3183	39
40	2.4314	2.0334	1.8293	1.6910	1.5863	1.5019	1.4314	1.3707	1.3174	40
41	2.4206	2.0291	1.8266	1.6890	1.5847	1.5007	1.4303	1.3697	1.3166	41
42	2.4102	2.0248	1.8239	1.6871	1.5832	1.4994	1.4292	1.3688	1.3158	42
43	2.4000	2.0206	1.8212	1.6851	1.5816	1.4981	1.4281	1.3678	1.3149	43
44	2.3900	2.0164	1.8186	1.6832	1.5801	1.4969	1.4270	1.3669	1.3141	44
45	2.3802	2.0122	1.8159	1.6812	1.5786	1.4956	1.4260	1.3660	1.3133	45
46	2.3707	2.0081	1.8133	1.6793	1.5771	1.4943	1.4249	1.3650	1.3124	46
47	2.3613	2.0040	1.8107	1.6774	1.5755	1.4931	1.4238	1.3641	1.3116	47
48	2.3522	2.0000	1.8081	1.6755	1.5740	1.4918	1.4228	1.3632	1.3108	48
49	2.3432	1.9960	1.8055	1.6736	1.5725	1.4906	1.4217	1.3623	1.3100	49
50	2.3345	1.9920	1.8030	1.6717	1.5710	1.4894	1.4206	1.3613	1.3091	50
51	2.3259	1.9881	1.8004	1.6698	1.5695	1.4881	1.4196	1.3604	1.3083	51
52	2.3174	1.9842	1.7979	1.6679	1.5680	1.4869	1.4185	1.3595	1.3075	52
53	2.3091	1.9803	1.7954	1.6661	1.5666	1.4856	1.4175	1.3586	1.3067	53
54	2.3010	1.9765	1.7929	1.6642	1.5651	1.4844	1.4164	1.3576	1.3059	54
55	2.2931	1.9727	1.7904	1.6624	1.5636	1.4832	1.4154	1.3567	1.3051	55
56	2.2852	1.9690	1.7879	1.6605	1.5621	1.4820	1.4143	1.3558	1.3043	56
57	2.2775	1.9652	1.7855	1.6587	1.5607	1.4808	1.4133	1.3549	1.3034	57
58	2.2700	1.9615	1.7830	1.6568	1.5592	1.4795	1.4122	1.3540	1.3026	58
59	2.2626	1.9579	1.7806	1.6550	1.5578	1.4783	1.4112	1.3531	1.3018	59
60	2.2553	1.9542	1.7782	1.6532	1.5563	1.4771	1.4102	1.3522	1.3010	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 0° 9′	h. m. 0° 10′	h. m. 0° 11′	h. m. 0° 12′	h. m. 0° 13′	h. m. 0° 14′	h. m. 0° 15′	h. m. 0° 16′	h. m. 0° 17′	s. ″
0	1.3010	1.2553	1.2139	1.1761	1.1413	1.1091	1.0792	1.0512	1.0248	0
1	1.3002	1.2545	1.2132	1.1755	1.1408	1.1086	1.0787	1.0507	1.0244	1
2	1.2994	1.2538	1.2126	1.1749	1.1402	1.1081	1.0782	1.0502	1.0240	2
3	1.2986	1.2531	1.2119	1.1743	1.1397	1.1076	1.0777	1.0498	1.0235	3
4	1.2978	1.2524	1.2113	1.1737	1.1391	1.1071	1.0773	1.0493	1.0231	4
5	1.2970	1.2517	1.2106	1.1731	1.1386	1.1066	1.0768	1.0489	1.0227	5
6	1.2962	1.2510	1.2099	1.1725	1.1380	1.1061	1.0763	1.0484	1.0223	6
7	1.2954	1.2502	1.2093	1.1719	1.1374	1.1055	1.0758	1.0480	1.0219	7
8	1.2946	1.2495	1.2086	1.1713	1.1369	1.1050	1.0753	1.0475	1.0214	8
9	1.2939	1.2488	1.2080	1.1707	1.1363	1.1045	1.0749	1.0471	1.0210	9
10	1.2931	1.2481	1.2073	1.1701	1.1358	1.1040	1.0744	1.0467	1.0206	10
11	1.2923	1.2474	1.2067	1.1695	1.1352	1.1035	1.0739	1.0462	1.0202	11
12	1.2915	1.2467	1.2061	1.1689	1.1347	1.1030	1.0734	1.0458	1.0197	12
13	1.2907	1.2460	1.2054	1.1683	1.1342	1.1025	1.0730	1.0453	1.0193	13
14	1.2899	1.2453	1.2048	1.1677	1.1336	1.1020	1.0725	1.0449	1.0189	14
15	1.2891	1.2445	1.2041	1.1671	1.1331	1.1015	1.0720	1.0444	1.0185	15
16	1.2883	1.2438	1.2035	1.1665	1.1325	1.1009	1.0715	1.0440	1.0181	16
17	1.2876	1.2431	1.2028	1.1660	1.1320	1.1004	1.0711	1.0435	1.0176	17
18	1.2868	1.2424	1.2022	1.1654	1.1314	1.0999	1.0706	1.0431	1.0172	18
19	1.2860	1.2417	1.2016	1.1648	1.1309	1.0994	1.0701	1.0426	1.0168	19
20	1.2852	1.2410	1.2009	1.1642	1.1303	1.0989	1.0696	1.0422	1.0164	20
21	1.2845	1.2403	1.2003	1.1636	1.1298	1.0984	1.0692	1.0418	1.0160	21
22	1.2837	1.2396	1.1996	1.1630	1.1292	1.0979	1.0687	1.0413	1.0156	22
23	1.2829	1.2389	1.1990	1.1624	1.1287	1.0974	1.0682	1.0409	1.0151	23
24	1.2821	1.2382	1.1984	1.1619	1.1282	1.0969	1.0678	1.0404	1.0147	24
25	1.2814	1.2375	1.1977	1.1613	1.1276	1.0964	1.0673	1.0400	1.0143	25
26	1.2806	1.2368	1.1971	1.1607	1.1271	1.0959	1.0668	1.0395	1.0139	26
27	1.2798	1.2362	1.1965	1.1601	1.1266	1.0954	1.0663	1.0391	1.0135	27
28	1.2791	1.2355	1.1958	1.1595	1.1260	1.0949	1.0659	1.0387	1.0131	28
29	1.2783	1.2348	1.1952	1.1589	1.1255	1.0944	1.0654	1.0382	1.0126	29
30	1.2775	1.2341	1.1946	1.1584	1.1249	1.0939	1.0649	1.0378	1.0122	30
31	1.2768	1.2334	1.1939	1.1578	1.1244	1.0934	1.0645	1.0374	1.0118	31
32	1.2760	1.2327	1.1933	1.1572	1.1239	1.0929	1.0640	1.0369	1.0114	32
33	1.2753	1.2320	1.1927	1.1566	1.1233	1.0924	1.0635	1.0365	1.0110	33
34	1.2745	1.2313	1.1921	1.1561	1.1228	1.0919	1.0631	1.0360	1.0106	34
35	1.2738	1.2307	1.1914	1.1555	1.1223	1.0914	1.0626	1.0356	1.0102	35
36	1.2730	1.2300	1.1908	1.1549	1.1217	1.0909	1.0621	1.0352	1.0098	36
37	1.2722	1.2293	1.1902	1.1543	1.1212	1.0904	1.0617	1.0347	1.0093	37
38	1.2715	1.2286	1.1896	1.1538	1.1207	1.0899	1.0612	1.0343	1.0089	38
39	1.2707	1.2279	1.1889	1.1532	1.1201	1.0894	1.0608	1.0339	1.0085	39
40	1.2700	1.2272	1.1883	1.1526	1.1196	1.0889	1.0603	1.0334	1.0081	40
41	1.2692	1.2266	1.1877	1.1520	1.1191	1.0884	1.0598	1.0330	1.0077	41
42	1.2685	1.2259	1.1871	1.1515	1.1186	1.0880	1.0594	1.0326	1.0073	42
43	1.2678	1.2252	1.1865	1.1509	1.1180	1.0875	1.0589	1.0321	1.0069	43
44	1.2670	1.2245	1.1859	1.1503	1.1175	1.0870	1.0585	1.0317	1.0065	44
45	1.2663	1.2239	1.1852	1.1498	1.1170	1.0865	1.0580	1.0313	1.0061	45
46	1.2655	1.2232	1.1846	1.1492	1.1164	1.0860	1.0575	1.0308	1.0057	46
47	1.2648	1.2225	1.1840	1.1486	1.1159	1.0855	1.0571	1.0304	1.0053	47
48	1.2640	1.2218	1.1834	1.1481	1.1154	1.0850	1.0566	1.0300	1.0049	48
49	1.2633	1.2212	1.1828	1.1475	1.1149	1.0845	1.0562	1.0295	1.0044	49
50	1.2626	1.2205	1.1822	1.1469	1.1143	1.0840	1.0557	1.0291	1.0040	50
51	1.2618	1.2198	1.1816	1.1464	1.1138	1.0835	1.0552	1.0287	1.0036	51
52	1.2611	1.2192	1.1809	1.1458	1.1133	1.0831	1.0548	1.0282	1.0032	52
53	1.2604	1.2185	1.1803	1.1452	1.1128	1.0826	1.0543	1.0278	1.0028	53
54	1.2596	1.2178	1.1797	1.1447	1.1123	1.0821	1.0539	1.0274	1.0024	54
55	1.2589	1.2172	1.1791	1.1441	1.1117	1.0816	1.0534	1.0270	1.0020	55
56	1.2582	1.2165	1.1785	1.1436	1.1112	1.0811	1.0530	1.0265	1.0016	56
57	1.2574	1.2159	1.1779	1.1430	1.1107	1.0806	1.0525	1.0261	1.0012	57
58	1.2567	1.2152	1.1773	1.1424	1.1102	1.0801	1.0521	1.0257	1.0008	58
59	1.2560	1.2145	1.1767	1.1419	1.1097	1.0797	1.0516	1.0252	1.0004	59
60	1.2553	1.2139	1.1761	1.1413	1.1091	1.0792	1.0512	1.0248	1.0000	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 0° 18′	h. m. 0° 19′	h. m. 0° 20′	h. m. 0° 21′	h. m. 0° 22′	h. m. 0° 23′	h. m. 0° 24′	h. m. 0° 25′	h. m. 0° 26′	h. m. 0° 27′	h. m. 0° 28′	h. m. 0° 29′	s. ″
0	10000	9765	9542	9331	9128	8935	8751	8573	8403	8239	8081	7929	0
1	9996	9761	9539	9327	9125	8932	8748	8570	8400	8236	8079	7926	1
2	9992	9758	9535	9324	9122	8929	8745	8568	8397	8234	8076	7924	2
3	9988	9754	9532	9320	9119	8926	8742	8565	8395	8231	8073	7921	3
4	9984	9750	9528	9317	9115	8923	8739	8562	8392	8228	8071	7919	4
5	9980	9746	9524	9313	9112	8920	8736	8559	8389	8226	8068	7916	5
6	9976	9742	9521	9310	9109	8917	8733	8556	8386	8223	8066	7914	6
7	9972	9739	9517	9306	9106	8913	8730	8553	8384	8220	8063	7911	7
8	9968	9735	9514	9303	9103	8910	8727	8550	8381	8218	8061	7909	8
9	9964	9731	9510	9300	9099	8907	8724	8547	8378	8215	8058	7906	9
10	9960	9727	9506	9296	9096	8904	8721	8544	8375	8212	8055	7904	10
11	9956	9723	9503	9293	9092	8901	8718	8542	8372	8210	8053	7901	11
12	9952	9720	9499	9289	9089	8898	8715	8539	8370	8207	8050	7899	12
13	9948	9716	9496	9286	9086	8895	8712	8536	8367	8204	8048	7896	13
14	9944	9712	9492	9283	9083	8892	8709	8533	8364	8202	8045	7894	14
15	9940	9708	9488	9279	9079	8888	8706	8530	8361	8199	8043	7891	15
16	9936	9705	9485	9276	9076	8885	8703	8527	8359	8196	8040	7889	16
17	9932	9701	9481	9272	9073	8882	8700	8524	8356	8194	8037	7887	17
18	9928	9697	9478	9269	9070	8879	8697	8522	8353	8191	8035	7884	18
19	9924	9693	9474	9266	9066	8876	8694	8519	8350	8188	8032	7882	19
20	9920	9690	9471	9202	9063	8873	8691	8516	8348	8186	8030	7879	20
21	9916	9686	9467	9259	9060	8870	8688	8513	8345	8183	8027	7877	21
22	9912	9682	9464	9255	9057	8867	8685	8510	8342	8 81	8025	7874	22
23	9908	9678	9460	9252	9053	8864	8682	8507	8339	8178	8022	7872	23
24	9905	9675	9456	9249	9050	8861	8679	8504	8337	8175	8020	7869	24
25	9901	9671	9453	9245	9047	8857	8676	8502	8334	8173	8017	7867	25
26	9897	9667	9419	9242	9044	8854	8673	8499	8331	8170	8014	7864	26
27	9893	9664	9446	9238	9041	8851	8670	8496	8328	8167	8012	7862	27
28	9889	9660	9442	9235	9037	8848	8667	8493	8326	8165	8009	7859	28
29	9885	9656	9439	9232	9034	8845	8664	8490	8323	8162	8007	7857	29
30	9881	9652	9435	9228	9031	8842	8661	8487	8320	8159	8004	7855	30
31	9877	9649	9432	9225	9028	8839	8658	8484	8318	8157	8002	7852	31
32	9873	9645	9428	9222	9024	8836	8655	8482	8315	8154	7999	7850	32
33	9869	9641	9425	9218	9021	8833	8652	8479	8312	8152	7997	7847	33
34	9865	9638	9421	9215	9018	8830	8649	8476	8309	8149	7994	7845	34
35	9861	9634	9418	9212	9015	8827	8646	8473	8307	8146	7992	7842	35
36	9858	9630	9414	9208	9012	8824	8643	8470	8304	8144	7989	7840	36
37	9854	9626	9411	9205	9008	8821	8640	8467	8301	8141	7987	7837	37
38	9850	9623	9407	9201	9005	8817	8637	8465	8298	8138	7984	7835	38
39	9846	9619	9404	9198	9002	8814	8635	8462	8296	8136	7981	7832	39
40	9842	9615	9400	9195	8999	8811	8632	8459	8293	8133	7979	7830	40
41	9838	9612	9397	9191	8996	8808	8629	8456	8290	8131	7976	7828	41
42	9834	9608	9393	9188	8992	8805	8626	8453	8288	8128	7974	7825	42
43	9830	9604	9390	9185	8989	8802	8623	8451	8285	8125	7971	7823	43
44	9827	9601	9386	9181	8986	8799	8620	8448	8282	8123	7969	7820	44
45	9823	9597	9383	9178	8983	8796	8617	8445	8279	8120	7966	7818	45
40	9819	9593	9379	9175	8980	8793	8614	8442	8277	8117	7964	7815	46
47	9815	9590	9376	9172	8977	8790	8611	8439	8274	8115	7961	7813	47
48	9811	9586	9372	9168	8973	8787	8608	8437	8271	8112	7959	7811	48
49	9807	9582	9369	9165	8970	8784	8605	8434	8269	8110	7956	7808	49
50	9803	9579	9365	9162	8967	8781	8602	8431	8266	8107	7954	7806	50
51	9800	9575	9362	9158	8964	8778	8599	8428	8263	8 04	7951	7803	51
52	9796	9571	9358	9155	8961	8775	8597	8425	8261	8102	7949	7801	52
53	9792	9568	9355	9152	8958	8772	8594	8423	8258	8099	7946	7798	53
54	9788	9564	9351	9148	8954	8769	8591	8420	8255	8097	7944	7796	54
55	9784	9561	9348	9145	8951	8766	8588	8417	8253	8094	7941	7794	55
56	9780	9557	9344	9142	8948	8763	8585	8414	8250	8091	7939	7791	56
57	9777	9553	9341	9138	8945	8760	8582	8411	8247	8089	7936	7789	57
58	9773	9550	9337	9135	8942	8757	8579	8409	8244	8086	7934	7786	58
59	9769	9546	9334	9132	8939	8754	8576	8406	8242	8084	7931	7784	59
60	9765	9542	9331	9128	8935	8751	8573	8403	8239	8081	7929	7782	60

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 0° 30′	h. m. 0° 31′	h. m. 0° 32′	h. m. 0° 33′	h. m. 0° 34′	h. m. 0° 35′	h. m. 0° 36′	h. m. 0° 37′	h. m. 0° 38′	h. m. 0° 39′	h. m. 0° 40′	h. m. 0° 41′	s. ″
0	7782	7639	7501	7368	7238	7112	6990	6871	6755	6642	6532	6425	0
1	7779	7637	7499	7365	7236	7110	6988	6869	6753	6640	6530	6423	1
2	7777	7634	7497	7363	7234	7108	6986	6867	6751	6638	6529	6421	2
3	7774	7632	7494	7361	7232	7106	6984	6865	6749	6637	6527	6420	3
4	7772	7630	7492	7359	7229	7104	6982	6863	6747	6635	6525	6418	4
5	7769	7627	7490	7357	7227	7102	6980	6861	6745	6633	6523	6416	5
6	7767	7625	7488	7354	7225	7100	6978	6859	6743	6631	6521	6414	6
7	7765	7623	7485	7352	7223	7098	6976	6857	6742	6629	6519	6413	7
8	7762	7620	7483	7350	7221	7096	6974	6855	6740	6627	6518	6411	8
9	7760	7618	7481	7348	7219	7093	6972	6853	6738	6625	6516	6409	9
10	7757	7616	7479	7346	7217	7091	6970	6851	6736	6624	6514	6407	10
11	7755	7613	7476	7344	7215	7089	6968	6849	6734	6622	6512	6406	11
12	7753	7611	7474	7341	7212	7087	6966	6847	6732	6620	6510	6404	12
13	7750	7609	7472	7339	7210	7085	6964	6845	6730	6618	6509	6402	13
14	7748	7607	7470	7337	7208	7083	6962	6843	6728	6616	6507	6400	14
15	7745	7604	7467	7335	7206	7081	6960	6841	6726	6614	6505	6398	15
16	7743	7602	7465	7333	7204	7079	6958	6840	6725	6612	6503	6397	16
17	7741	7600	7463	7330	7202	7077	6956	6838	6723	6611	6501	6395	17
18	7738	7597	7461	7328	7200	7075	6954	6836	6721	6609	6500	6393	18
19	7736	7595	7458	7326	7198	7073	6952	6834	6719	6607	6498	6391	19
20	7734	7593	7456	7324	7196	7071	6950	6832	6717	6605	6496	6390	20
21	7731	7590	7454	7322	7193	7069	6948	6830	6715	6603	6494	6388	21
22	7729	7588	7452	7320	7191	7067	6946	6828	6713	6601	6492	6386	22
23	7726	7586	7450	7317	7189	7065	6944	6826	6711	6600	6491	6384	23
24	7724	7583	7447	7315	7187	7063	6942	6824	6709	6598	6489	6383	24
25	7722	7581	7445	7313	7185	7061	6940	6822	6708	6596	6487	6381	25
26	7719	7579	7443	7311	7183	7059	6938	6820	6706	6594	6485	6379	26
27	7717	7577	7441	7309	7181	7057	6936	6818	6704	6592	6484	6377	27
28	7714	7574	7438	7307	7179	7055	6934	6816	6702	6590	6482	6376	28
29	7712	7572	7436	7304	7177	7052	6932	6814	6700	6589	6480	6374	29
30	7710	7570	7434	7302	7175	7050	6930	6812	6698	6587	6478	6372	30
31	7707	7567	7432	7300	7172	7048	6928	6810	6696	6585	6476	6371	31
32	7705	7565	7429	7298	7170	7046	6926	6809	6694	6583	6475	6369	32
33	7703	7563	7427	7296	7168	7044	6924	6807	6692	6581	6473	6367	33
34	7700	7560	7425	7294	7166	7042	6922	6805	6691	6579	6471	6365	34
35	7698	7558	7423	7291	7164	7040	6920	6803	6689	6578	6469	6364	35
36	7696	7556	7421	7289	7162	7038	6918	6801	6687	6576	6467	6362	36
37	7693	7554	7418	7287	7160	7036	6916	6799	6685	6574	6466	6360	37
38	7691	7551	7416	7285	7158	7034	6914	6797	6683	6572	6464	6358	38
39	7688	7549	7414	7283	7156	7032	6912	6795	6681	6570	6462	6357	39
40	7686	7547	7412	7281	7154	7030	6910	6793	6679	6568	6460	6355	40
41	7684	7544	7409	7279	7152	7028	6908	6791	6677	6567	6459	6353	41
42	7681	7542	7407	7276	7149	7026	6906	6789	6676	6565	6457	6351	42
43	7679	7540	7405	7274	7147	7024	6904	6787	6674	6563	6455	6350	43
44	7677	7538	7403	7272	7145	7022	6902	6785	6672	6561	6453	6348	44
45	7674	7535	7401	7270	7143	7020	6900	6784	6670	6559	6451	6346	45
46	7672	7533	7398	7268	7141	7018	6898	6782	6668	6558	6450	6344	46
47	7670	7531	7396	7266	7139	7016	6896	6780	6666	6556	6448	6343	47
48	7667	7528	7394	7264	7137	7014	6894	6778	6664	6554	6446	6341	48
49	7665	7526	7392	7261	7135	7012	6892	6776	6663	6552	6444	6339	49
50	7663	7524	7390	7259	7133	7010	6890	6774	6661	6550	6443	6338	50
51	7660	7522	7387	7257	7131	7008	6888	6772	6659	6548	6441	6336	51
52	7658	7519	7385	7255	7129	7006	6886	6770	6657	6547	6439	6334	52
53	7655	7517	7383	7253	7127	7004	6884	6768	6655	6545	6437	6332	53
54	7653	7515	7381	7251	7124	7002	6882	6766	6653	6543	6435	6331	54
55	7651	7513	7379	7249	7122	7000	6881	6764	6651	6541	6434	6329	55
56	7648	7510	7376	7246	7120	6998	6879	6763	6650	6539	6432	6327	56
57	7646	7508	7374	7244	7118	6996	6877	6761	6648	6538	6430	6325	57
58	7644	7506	7372	7242	7116	6994	6875	6759	6646	6536	6428	6324	58
59	7641	7503	7370	7240	7114	6992	6873	6757	6644	6534	6427	6322	59
60	7639	7501	7368	7238	7112	6990	6871	6755	6642	6532	6425	6320	60

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 0° 42′	h. m. 0° 43′	h. m. 0° 44′	h. m. 0° 45	h. m. 0° 46′	h. m. 0° 47′	h. m. 0° 48′	h. m. 0° 49′	h. m. 0° 50′	h. m. 0° 51′	h. m. 0° 52′	h. m. 0° 53′	s. ″
0	6320	6218	6118	6021	5925	5832	5740	5651	5563	5477	5393	5310	0
1	6319	6216	6117	6019	5924	5830	5739	5649	5562	5476	5391	5309	1
2	6317	6215	6115	6017	5922	5829	5737	5648	5560	5474	5390	5307	2
3	6315	6213	6113	6016	5920	5827	5736	5646	5559	5473	5389	5306	3
4	6313	6211	6112	6014	5919	5826	5734	5645	5557	5471	5387	5305	4
5	6312	6210	6110	6013	5917	5824	5733	5643	5556	5470	5386	5303	5
6	6310	6208	6108	6011	5916	5823	5731	5642	5554	5469	5384	5302	6
7	6308	6206	6107	6009	5914	5821	5730	5640	5553	5467	5383	5300	7
8	6306	6205	6105	6008	5913	5819	5728	5639	5551	5466	5382	5299	8
9	6305	6203	6103	6006	5911	5818	5727	5637	5550	5464	5380	5298	9
10	6303	6201	6102	6005	5909	5816	5725	5636	5549	5463	5379	5296	10
11	6301	6200	6100	6003	5908	5815	5724	5635	5547	5461	5377	5295	11
12	6300	6198	6099	6001	5906	5813	5722	5633	5546	5460	5376	5294	12
13	6298	6196	6097	6000	5905	5812	5721	5632	5544	5459	5375	5292	13
14	6296	6195	6095	5998	5903	5810	5719	5630	5543	5457	5373	5291	14
15	6294	6193	6094	5997	5902	5809	5718	5629	5541	5456	5372	5290	15
16	6293	6191	6092	5995	5900	5807	5716	5627	5540	5454	5370	5288	16
17	6291	6190	6090	5993	5898	5806	5715	5626	5538	5453	5369	5287	17
18	6289	6188	6089	5992	5897	5804	5713	5624	5537	5452	5368	5285	18
19	6288	6186	6087	5990	5895	5803	5712	5623	5536	5450	5366	5284	19
20	6286	6185	6085	5989	5894	5801	5710	5621	5534	5449	5365	5283	20
21	6284	6183	6084	5987	5892	5800	5709	5620	5533	5447	5364	5281	21
22	6282	6181	6082	5985	5891	5798	5707	5618	5531	5446	5362	5280	22
23	6281	6179	6081	5984	5889	5796	5706	5617	5530	5445	5361	5279	23
24	6279	6178	6079	5982	5888	5795	5704	5615	5528	5443	5359	5277	24
25	6277	6176	6077	5981	5886	5793	5703	5614	5527	5442	5358	5276	25
26	6276	6174	6076	5979	5884	5792	5701	5613	5526	5440	5357	5275	26
27	6274	6173	6074	5977	5883	5790	5700	5611	5524	5439	5355	5273	27
28	6272	6171	6072	5976	5881	5789	5698	5610	5522	5437	5354	5272	28
29	6271	6169	6071	5974	5880	5787	5697	5608	5521	5436	5353	5271	29
30	6269	6168	6069	5973	5878	5786	5695	5607	5520	5435	5351	5269	30
31	6267	6166	6067	5971	5877	5784	5694	5605	5518	5433	5350	5268	31
32	6265	6165	6066	5969	5875	5783	5692	5604	5517	5432	5348	5266	32
33	6264	6163	6064	5968	5874	5781	5691	5602	5516	5430	5347	5265	33
34	6262	6161	6063	5966	5872	5780	5689	5601	5514	5429	5346	5264	34
35	6260	6160	6061	5965	5870	5778	5688	5599	5513	5428	5344	5262	35
36	6259	6158	6059	5963	5869	5777	5686	5598	5511	5426	5343	5261	36
37	6257	6156	6058	5961	5867	5775	5685	5596	5510	5425	5341	5260	37
38	6255	6155	6056	5960	5866	5774	5683	5595	5508	5423	5340	5258	38
39	6254	6153	6055	5958	5864	5772	5682	5594	5507	5422	5339	5257	39
40	6252	6151	6053	5957	5863	5771	5680	5592	5506	5421	5337	5256	40
41	6250	6150	6051	5955	5861	5769	5679	5591	5504	5419	5336	5254	41
42	6248	6148	6050	5954	5860	5768	5677	5589	5503	5418	5335	5253	42
43	6247	6146	6048	5952	5858	5766	5676	5588	5501	5416	5333	5252	43
44	6245	6145	6046	5950	5856	5765	5674	5586	5500	5415	5332	5250	44
45	6243	6143	6045	5949	5855	5763	5673	5585	5498	5414	5331	5249	45
46	6242	6141	6043	5947	5853	5761	5671	5583	5497	5412	5329	5248	46
47	6240	6140	6042	5946	5852	5760	5670	5582	5496	5411	5328	5246	47
48	6238	6138	6040	5944	5850	5758	5669	5580	5494	5409	5326	5245	48
49	6237	6136	6038	5942	5849	5757	5667	5579	5493	5408	5325	5244	49
50	6235	6135	6037	5941	5847	5755	5666	5578	5491	5407	5324	5242	50
51	6233	6133	6035	5939	5846	5754	5664	5576	5490	5405	5322	5241	51
52	6232	6131	6033	5938	5844	5752	5663	5575	5488	5404	5321	5240	52
53	6230	6130	6032	5936	5843	5751	5661	5573	5487	5402	5320	5238	53
54	6228	6128	6030	5935	5841	5749	5660	5572	5486	5401	5318	5237	54
55	6226	6126	6029	5933	5839	5748	5658	5570	5484	5400	5317	5235	55
56	6225	6125	6027	5931	5838	5746	5657	5569	5483	5398	5315	5234	56
57	6223	6123	6025	5930	5836	5745	5655	5567	5481	5397	5314	5233	57
58	6221	6121	6024	5928	5835	5743	5654	5566	5480	5395	5313	5231	58
59	6220	6120	6022	5927	5833	5742	5652	5564	5478	5394	5311	5230	59
60	6218	6118	6021	5925	5832	5740	5651	5562	5477	5393	5310	5229	60

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 0° 54′	h. m. 0° 55′	h. m. 0° 56′	h. m. 0° 57′	h. m. 0° 58′	h. m. 0° 59′	h. m. 1° 0′	h. m. 1° 1′	h. m. 1° 2′	h. m. 1° 3′	h. m. 1° 4′	h. m. 1° 5′	s. ″
0	5229	5149	5071	4994	4918	4844	4771	4699	4629	4559	4491	4424	0
1	5227	5148	5070	4993	4917	4843	4770	4698	4628	4558	4490	4422	1
2	5226	5146	5068	4991	4916	4842	4769	4697	4626	4557	4489	4421	2
3	5225	5145	5067	4990	4915	4841	4768	4696	4625	4556	4488	4420	3
4	5223	5144	5066	4989	4913	4839	4766	4695	4624	4555	4486	4419	4
5	5222	5143	5064	4988	4912	4838	4765	4693	4623	4554	4485	4418	5
6	5221	5141	5063	4986	4911	4837	4764	4692	4622	4552	4484	4417	6
7	5219	5140	5062	4985	4910	4836	4763	4691	4621	4551	4483	4416	7
8	5218	5139	5061	4984	4908	4834	4762	4690	4619	4550	4482	4415	8
9	5217	5137	5059	4983	4907	4833	4760	4689	4618	4549	4481	4414	9
10	5215	5136	5058	4981	4906	4832	4759	4688	4617	4548	4480	4412	10
11	5214	5135	5057	4980	4905	4831	4758	4686	4616	4547	4479	4411	11
12	5213	5133	5055	4979	4903	4830	4757	4685	4615	4546	4477	4410	12
13	5211	5132	5054	4977	4902	4828	4756	4684	4614	4544	4476	4409	13
14	5210	5131	5053	4976	4901	4827	4754	4683	4612	4543	4475	4408	14
15	5209	5129	5051	4975	4900	4826	4753	4682	4611	4542	4474	4407	15
16	5207	5128	5050	4974	4899	4825	4752	4680	4610	4541	4473	4406	16
17	5206	5127	5049	4972	4897	4823	4751	4679	4609	4540	4472	4405	17
18	5205	5125	5048	4971	4896	4822	4750	4678	4608	4539	4471	4404	18
19	5203	5124	5046	4970	4895	4821	4748	4677	4607	4538	4469	4402	19
20	5202	5123	5045	4969	4894	4820	4747	4676	4606	4536	4468	4401	20
21	5201	5122	5044	4967	4892	4819	4746	4675	4604	4535	4467	4400	21
22	5199	5120	5043	4966	4891	4817	4745	4673	4603	4534	4466	4399	22
23	5198	5119	5041	4965	4890	4816	4744	4672	4602	4533	4465	4398	23
24	5197	5118	5040	4964	4889	4815	4742	4671	4601	4532	4464	4397	24
25	5195	5116	5039	4962	4887	4814	4741	4670	4600	4531	4463	4396	25
26	5194	5115	5037	4961	4886	4812	4740	4669	4599	4530	4462	4395	26
27	5193	5114	5036	4960	4885	4811	4739	4668	4597	4528	4460	4394	27
28	5191	5112	5035	4959	4884	4810	4738	4666	4596	4527	4459	4393	28
29	5190	5111	5034	4957	4882	4809	4736	4665	4595	4526	4458	4391	29
30	5189	5110	5032	4956	4881	4808	4735	4664	4594	4525	4457	4390	30
31	5187	5108	5031	4955	4880	4806	4734	4663	4593	4524	4456	4389	31
32	5186	5107	5030	4954	4879	4805	4733	4662	4592	4523	4455	4388	32
33	5185	5106	5028	4952	4877	4804	4732	4660	4590	4522	4454	4387	33
34	5183	5105	5027	4951	4876	4803	4730	4659	4589	4520	4453	4386	34
35	5182	5103	5026	4950	4875	4801	4729	4658	4588	4519	4452	4385	35
36	5181	5102	5025	4949	4874	4800	4728	4657	4587	4518	4450	4384	36
37	5179	5101	5023	4947	4873	4799	4727	4656	4586	4517	4449	4383	37
38	5178	5099	5022	4946	4871	4798	4726	4655	4585	4516	4448	4381	38
39	5177	5098	5021	4945	4870	4797	4724	4653	4584	4515	4447	4380	39
40	5175	5097	5019	4943	4869	4795	4723	4652	4582	4514	4446	4379	40
41	5174	5095	5018	4942	4868	4794	4722	4651	4581	4512	4445	4378	41
42	5173	5094	5017	4941	4866	4793	4721	4650	4580	4511	4444	4377	42
43	5172	5093	5016	4940	4865	4792	4720	4649	4579	4510	4443	4376	43
44	5170	5092	5014	4938	4864	4791	4718	4648	4578	4509	4441	4375	44
45	5169	5090	5013	4937	4863	4789	4717	4646	4577	4508	4440	4374	45
46	5168	5089	5012	4936	4861	4788	4716	4645	4575	4507	4439	4373	46
47	5166	5088	5011	4935	4860	4787	4715	4644	4574	4506	4438	4372	47
48	5165	5086	5009	4933	4859	4786	4714	4643	4573	4505	4437	4370	48
49	5164	5085	5008	4932	4858	4785	4712	4642	4572	4503	4436	4369	49
50	5162	5084	5007	4931	4856	4783	4711	4640	4571	4502	4435	4368	50
51	5161	5082	5005	4930	4855	4782	4710	4639	4570	4501	4434	4367	51
52	5160	5081	5004	4928	4854	4781	4709	4638	4569	4500	4433	4366	52
53	5158	5080	5003	4927	4853	4780	4708	4637	4567	4499	4431	4365	53
54	5157	5079	5002	4926	4852	4778	4707	4636	4566	4498	4430	4364	54
55	5156	5077	5000	4925	4850	4777	4705	4635	4565	4497	4429	4363	55
56	5154	5076	4999	4923	4849	4776	4704	4633	4564	4495	4428	4362	56
57	5153	5075	4998	4922	4848	4775	4703	4632	4563	4494	4427	4361	57
58	5152	5073	4997	4921	4847	4774	4702	4631	4562	4493	4426	4359	58
59	5150	5072	4995	4920	4845	4772	4701	4630	4560	4492	4425	4358	59
60	5149	5071	4994	4918	4844	4771	4699	4629	4559	4491	4424	4357	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 1° 6′	h. m. 1° 7′	h. m. 1° 8′	h. m. 1° 9′	h. m. 1° 10′	h. m. 1° 11′	h. m. 1° 12′	h. m. 1° 13′	h. m. 1° 14′	h. m. 1° 15′	h. m. 1° 16′	h. m. 1° 17′	s. ″
0	4357	4292	4228	4164	4102	4040	3979	3919	3860	3802	3745	3688	0
1	4356	4291	4227	4163	4101	4039	3978	3919	3859	3801	3744	3687	1
2	4355	4290	4226	4162	4100	4038	3977	3918	3858	3800	3743	3686	2
3	4354	4289	4224	4161	4099	4037	3976	3917	3857	3799	3742	3685	3
4	4353	4288	4223	4160	4098	4036	3975	3916	3856	3798	3741	3684	4
5	4352	4287	4222	4159	4097	4035	3974	3915	3856	3797	3740	3683	5
6	4351	4285	4221	4158	4096	4034	3973	3914	3855	3796	3739	3682	6
7	4350	4284	4220	4157	4095	4033	3972	3913	3854	3795	3738	3681	7
8	4349	4283	4219	4156	4093	4032	3971	3912	3853	3794	3737	3680	8
9	4347	4282	4218	4155	4092	4031	3970	3911	3852	3793	3736	3679	9
10	4346	4281	4217	4154	4091	4030	3969	3910	3851	3792	3735	3678	10
11	4345	4280	4216	4153	4090	4029	3968	3909	3850	3792	3734	3677	11
12	4344	4279	4215	4152	4089	4028	3967	3908	3849	3791	3733	3677	12
13	4343	4278	4214	4151	4088	4027	3966	3907	3848	3790	3732	3676	13
14	4342	4277	4213	4150	4087	4026	3965	3906	3847	3789	3731	3675	14
15	4341	4276	4212	4149	4086	4025	3964	3905	3846	3788	3730	3674	15
16	4340	4275	4211	4147	4085	4024	3963	3904	3845	3787	3729	3673	16
17	4339	4274	4210	4146	4084	4023	3962	3903	3844	3786	3728	3672	17
18	4338	4273	4209	4145	4083	4022	3961	3902	3843	3785	3727	3671	18
19	4336	4271	4207	4144	4082	4021	3960	3901	3842	3784	3727	3670	19
20	4335	4270	4206	4143	4081	4020	3959	3900	3841	3783	3726	3669	20
21	4334	4269	4205	4142	4080	4019	3958	3899	3840	3782	3725	3668	21
22	4333	4268	4204	4141	4079	4018	3957	3898	3839	3781	3724	3667	22
23	4332	4267	4203	4140	4078	4017	3956	3897	3838	3780	3723	3666	23
24	4331	4266	4202	4139	4077	4016	3955	3896	3837	3779	3722	3665	24
25	4330	4265	4201	4138	4076	4015	3954	3895	3836	3778	3721	3664	25
26	4329	4264	4200	4137	4075	4014	3953	3894	3835	3777	3720	3663	26
27	4328	4263	4199	4136	4074	4013	3952	3893	3834	3776	3719	3663	27
28	4327	4262	4198	4135	4073	4012	3951	3892	3833	3775	3718	3662	28
29	4326	4261	4197	4134	4072	4011	3950	3891	3832	3774	3717	3661	29
30	4325	4260	4196	4133	4071	4010	3949	3890	3831	3773	3716	3660	30
31	4323	4259	4195	4132	4070	4009	3948	3889	3830	3772	3715	3659	31
32	4322	4258	4194	4131	4069	4008	3947	3888	3829	3771	3714	3658	32
33	4321	4256	4193	4130	4068	4007	3946	3887	3828	3770	3713	3657	33
34	4320	4255	4192	4129	4067	4006	3945	3886	3827	3769	3712	3656	34
35	4319	4254	4191	4128	4066	4005	3944	3885	3826	3768	3711	3655	35
36	4318	4253	4189	4127	4065	4004	3943	3884	3825	3768	3710	3654	36
37	4317	4252	4188	4126	4064	4003	3942	3883	3824	3767	3709	3653	37
38	4316	4251	4187	4125	4063	4002	3941	3882	3823	3766	3709	3652	38
39	4315	4250	4186	4124	4062	4001	3940	3881	3822	3765	3708	3651	39
40	4314	4249	4185	4122	4061	4000	3939	3880	3821	3764	3707	3650	40
41	4313	4248	4184	4121	4060	3999	3938	3879	3820	3763	3706	3649	41
42	4311	4247	4183	4120	4059	3998	3937	3878	3820	3762	3705	3649	42
43	4310	4246	4182	4119	4058	3997	3936	3877	3819	3761	3704	3648	43
44	4309	4245	4181	4118	4056	3996	3935	3876	3818	3760	3703	3647	44
45	4308	4244	4180	4117	4055	3995	3934	3875	3817	3759	3702	3646	45
46	4307	4243	4179	4116	4054	3993	3933	3874	3816	3758	3701	3645	46
47	4306	4241	4178	4115	4053	3992	3932	3873	3815	3757	3700	3644	47
48	4305	4240	4177	4114	4052	3991	3931	3872	3814	3756	3699	3643	48
49	4304	4239	4176	4113	4051	3990	3930	3871	3813	3755	3698	3642	49
50	4303	4238	4175	4112	4050	3989	3929	3870	3812	3754	3697	3641	50
51	4302	4237	4174	4111	4049	3988	3928	3869	3811	3753	3696	3640	51
52	4301	4236	4173	4110	4048	3987	3927	3868	3810	3752	3695	3639	52
53	4300	4235	4172	4109	4047	3986	3926	3867	3809	3751	3694	3638	53
54	4298	4234	4171	4108	4046	3985	3925	3866	3808	3750	3693	3637	54
55	4297	4233	4169	4107	4045	3984	3924	3865	3807	3749	3693	3636	55
56	4296	4232	4168	4106	4044	3983	3923	3864	3806	3748	3692	3635	56
57	4295	4231	4167	4105	4043	3982	3922	3863	3805	3747	3691	3635	57
58	4294	4230	4166	4104	4042	3981	3921	3862	3804	3746	3690	3634	58
59	4293	4229	4165	4103	4041	3980	3920	3861	3803	3746	3689	3633	59
60	4292	4228	4164	4102	4040	3979	3919	3860	3802	3745	3688	3632	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 1° 18′	h. m. 1° 19′	h. m. 1° 20′	h. m. 1° 21′	h. m. 1° 22′	h. m. 1° 23′	h. m. 1° 24′	h. m. 1° 25′	h. m. 1° 26′	h. m. 1° 27′	h. m. 1° 28′	h. m. 1° 29′	s. ″
0	3632	3576	3522	3468	3415	3362	3310	3259	3208	3158	3108	3059	0
1	3631	3576	3521	3467	3414	3361	3309	3258	3207	3157	3107	3058	1
2	3630	3575	3520	3466	3413	3360	3308	3257	3206	3156	3106	3057	2
3	3629	3574	3519	3465	3412	3359	3307	3256	3205	3155	3105	3056	3
4	3628	3573	3518	3464	3411	3358	3306	3255	3204	3154	3105	3056	4
5	3627	3572	3517	3463	3410	3358	3306	3254	3204	3153	3104	3055	5
6	3626	3571	3516	3463	3409	3357	3305	3253	3203	3153	3103	3054	6
7	3625	3570	3515	3462	3408	3356	3304	3253	3202	3152	3102	3053	7
8	3624	3569	3514	3461	3408	3355	3303	3252	3201	3151	3101	3052	8
9	3623	3568	3514	3460	3407	3354	3302	3251	3200	3150	3101	3052	9
10	3623	3567	3513	3459	3406	3353	3301	3250	3199	3149	3100	3051	10
11	3622	3566	3512	3458	3405	3352	3300	3249	3198	3148	3099	3050	11
12	3621	3565	3511	3457	3404	3351	3300	3248	3198	3148	3098	3049	12
13	3620	3565	3510	3456	3403	3351	3299	3247	3197	3147	3097	3048	13
14	3619	3564	3509	3455	3402	3350	3298	3247	3196	3146	3096	3047	14
15	3618	3563	3508	3454	3401	3349	3297	3246	3195	3145	3096	3047	15
16	3617	3562	3507	3454	3400	3348	3296	3245	3194	3144	3095	3046	16
17	3616	3561	3506	3453	3400	3347	3295	3244	3193	3143	3094	3045	17
18	3615	3560	3506	3452	3399	3346	3294	3243	3193	3143	3093	3044	18
19	3614	3559	3505	3451	3398	3345	3294	3242	3192	3142	3092	3043	19
20	3613	3558	3504	3450	3397	3345	3293	3242	3191	3141	3091	3043	20
21	3612	3557	3503	3449	3396	3344	3292	3241	3190	3140	3091	3042	21
22	3611	3556	3502	3448	3395	3343	3291	3240	3189	3139	3090	3041	22
23	3610	3555	3501	3447	3394	3342	3290	3239	3188	3138	3089	3040	23
24	3610	3555	3500	3446	3393	3341	3289	3238	3188	3138	3088	3039	24
25	3609	3554	3499	3446	3393	3340	3288	3237	3187	3137	3087	3039	25
26	3608	3553	3498	3445	3392	3339	3288	3236	3186	3136	3087	3038	26
27	3607	3552	3497	3444	3391	3338	3287	3236	3185	3135	3086	3037	27
28	3606	3551	3497	3443	3390	3338	3286	3235	3184	3134	3085	3036	28
29	3605	3550	3496	3442	3389	3337	3285	3234	3183	3133	3084	3035	29
30	3604	3549	3495	3441	3388	3336	3284	3233	3183	3133	3083	3034	30
31	3603	3548	3494	3440	3387	3335	3283	3232	3182	3132	3082	3034	31
32	3602	3547	3493	3439	3386	3334	3282	3231	3181	3131	3082	3033	32
33	3601	3546	3492	3438	3386	3333	3282	3231	3180	3130	3081	3032	33
34	3600	3545	3491	3438	3385	3332	3281	3230	3179	3129	3080	3031	34
35	3599	3545	3490	3437	3384	3332	3280	3229	3178	3129	3079	3030	35
36	3598	3544	3489	3436	3383	3331	3279	3228	3178	3128	3078	3030	36
37	3598	3543	3488	3435	3382	3330	3278	3227	3177	3127	3078	3029	37
38	3597	3542	3488	3434	3381	3329	3277	3226	3176	3126	3077	3028	38
39	3596	3541	3487	3433	3380	3328	3276	3225	3175	3125	3076	3027	39
40	3595	3540	3486	3432	3379	3327	3276	3225	3174	3124	3075	3026	40
41	3594	3539	3485	3431	3379	3326	3275	3224	3173	3124	3074	3026	41
42	3593	3538	3484	3431	3378	3325	3274	3223	3173	3123	3073	3025	42
43	3592	3537	3483	3430	3377	3325	3273	3222	3172	3122	3073	3024	43
44	3591	3536	3482	3429	3376	3324	3272	3221	3171	3121	3072	3023	44
45	3590	3535	3481	3428	3375	3323	3271	3220	3170	3120	3071	3022	45
46	3589	3535	3480	3427	3374	3322	3270	3220	3169	3119	3070	3022	46
47	3588	3534	3480	3426	3373	3321	3270	3219	3168	3119	3069	3021	47
48	3587	3533	3479	3425	3372	3320	3269	3218	3168	3118	3069	3020	48
49	3587	3532	3478	3424	3372	3319	3268	3217	3167	3117	3068	3019	49
50	3586	3531	3477	3423	3371	3319	3267	3216	3166	3116	3067	3018	50
51	3585	3530	3476	3423	3370	3318	3266	3215	3165	3115	3066	3018	51
52	3584	3529	3475	3422	3369	3317	3265	3214	3164	3114	3065	3017	52
53	3583	3528	3474	3421	3368	3316	3265	3214	3163	3114	3065	3016	53
54	3582	3527	3473	3420	3367	3315	3264	3213	3163	3113	3064	3015	54
55	3581	3526	3472	3419	3366	3314	3263	3212	3162	3112	3063	3014	55
56	3580	3525	3471	3418	3365	3313	3262	3211	3161	3111	3062	3014	56
57	3579	3525	3471	3417	3365	3313	3261	3210	3160	3110	3001	3013	57
58	3578	3524	3470	3416	3364	3312	3260	3209	3159	3110	3060	3012	58
59	3577	3523	3469	3415	3363	3311	3259	3209	3158	3109	3060	3011	59
60	3576	3522	3468	3415	3362	3310	3259	3208	3158	3108	3059	3010	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 1° 30′	h. m. 1° 31′	h. m. 1° 32′	h. m. 1° 33′	h. m. 1° 34′	h. m. 1° 35′	h. m. 1° 36′	h. m. 1° 37′	h. m. 1° 38′	h. m. 1° 39′	h. m. 1° 40′	h. m. 1° 41′	s. ″
0	3010	2962	2915	2868	2821	2775	2730	2685	2640	2596	2553	2510	0
1	3009	2962	2914	2867	2821	2775	2729	2684	2640	2596	2552	2509	1
2	3009	2961	2913	2866	2820	2774	2729	2684	2639	2595	2551	2508	2
3	3008	2960	2912	2866	2819	2773	2728	2683	2638	2594	2551	2507	3
4	3007	2959	2912	2865	2818	2772	2727	2682	2638	2593	2550	2507	4
5	3006	2958	2911	2864	2818	2772	2726	2681	2637	2593	2549	2506	5
6	3005	2958	2910	2863	2817	2771	2725	2681	2636	2592	2548	2505	6
7	3005	2957	2909	2862	2816	2770	2725	2680	2635	2591	2548	2504	7
8	3004	2956	2909	2862	2815	2769	2724	2679	2635	2591	2547	2504	8
9	3003	2955	2908	2861	2815	2769	2723	2678	2634	2590	2546	2503	9
10	3002	2954	2907	2860	2814	2768	2722	2678	2633	2589	2545	2502	10
11	3001	2954	2906	2859	2813	2767	2722	2677	2632	2588	2545	2502	11
12	3001	2953	2905	2859	2812	2766	2721	2676	2632	2588	2544	2501	12
13	3000	2952	2905	2858	2811	2766	2720	2675	2631	2587	2543	2500	13
14	2999	2951	2904	2857	2811	2765	2719	2675	2630	2586	2543	2499	14
15	2998	2950	2903	2856	2810	2764	2719	2674	2629	2585	2542	2499	15
16	2997	2950	2902	2855	2809	2763	2718	2673	2629	2585	2541	2498	16
17	2997	2949	2901	2855	2808	2763	2717	2672	2628	2584	2540	2497	17
18	2996	2948	2901	2854	2808	2762	2716	2672	2627	2583	2540	2497	18
19	2995	2947	2900	2853	2807	2761	2716	2671	2626	2583	2539	2496	19
20	2994	2946	2899	2852	2806	2760	2715	2670	2626	2582	2538	2495	20
21	2993	2946	2898	2852	2805	2760	2714	2669	2625	2581	2538	2494	21
22	2993	2945	2898	2851	2805	2759	2713	2669	2624	2580	2537	2494	22
23	2992	2944	2897	2850	2804	2758	2713	2668	2624	2580	2536	2493	23
24	2991	2943	2896	2849	2803	2757	2712	2667	2623	2579	2535	2492	24
25	2990	2942	2895	2848	2802	2756	2711	2666	2622	2578	2535	2492	25
26	2989	2942	2894	2848	2801	2756	2710	2666	2621	2577	2534	2491	26
27	2989	2941	2894	2847	2801	2755	2710	2665	2621	2577	2533	2490	27
28	2988	2940	2893	2846	2800	2754	2709	2664	2620	2576	2533	2489	28
29	2987	2939	2892	2845	2799	2753	2708	2663	2619	2575	2532	2489	29
30	2986	2939	2891	2845	2798	2753	2707	2663	2618	2574	2531	2488	30
31	2985	2938	2891	2844	2798	2752	2707	2662	2618	2574	2530	2487	31
32	2985	2937	2890	2843	2797	2751	2706	2661	2617	2573	2530	2487	32
33	2984	2936	2889	2842	2796	2750	2705	2660	2616	2572	2529	2486	33
34	2983	2935	2888	2842	2795	2750	2704	2660	2615	2572	2528	2485	34
35	2982	2935	2887	2841	2795	2749	2704	2659	2615	2571	2527	2485	35
36	2981	2934	2887	2840	2794	2748	2703	2658	2614	2570	2527	2484	36
37	2981	2933	2886	2839	2793	2747	2702	2657	2613	2569	2526	2483	37
38	2980	2932	2885	2838	2792	2747	2701	2657	2612	2569	2525	2482	38
39	2979	2931	2884	2838	2792	2746	2701	2656	2612	2568	2525	2482	39
40	2978	2931	2883	2837	2791	2745	2700	2655	2611	2567	2524	2481	40
41	2977	2930	2883	2836	2790	2744	2699	2655	2610	2566	2523	2480	41
42	2977	2929	2882	2835	2789	2744	2698	2654	2610	2566	2522	2480	42
43	2976	2928	2881	2835	2788	2743	2698	2653	2609	2565	2522	2479	43
44	2975	2927	2880	2834	2788	2742	2697	2652	2608	2564	2521	2478	44
45	2974	2927	2880	2833	2787	2741	2696	2652	2607	2564	2520	2477	45
46	2973	2926	2879	2832	2786	2741	2695	2651	2607	2563	2520	2477	46
47	2973	2925	2878	2831	2785	2740	2695	2650	2606	2562	2519	2476	47
48	2072	2924	2877	2831	2785	2739	2694	2649	2605	2561	2518	2475	48
49	2971	2924	2876	2830	2784	2738	2693	2649	2604	2561	2517	2475	49
50	2970	2923	2876	2829	2783	2738	2692	2648	2604	2560	2517	2474	50
51	2969	2922	2875	2828	2782	2737	2692	2647	2603	2559	2516	2473	51
52	2969	2921	2874	2828	2782	2736	2691	2646	2602	2559	2515	2472	52
53	2968	2920	2873	2827	2781	2735	2690	2646	2601	2558	2515	2472	53
54	2967	2920	2873	2826	2780	2735	2689	2645	2601	2557	2514	2471	54
55	2966	2919	2872	2825	2779	2734	2689	2644	2600	2556	2513	2470	55
56	2965	2918	2871	2825	2779	2733	2688	2643	2599	2556	2512	2470	56
57	2965	2917	2870	2824	2778	2732	2687	2643	2599	2555	2512	2469	57
58	2964	2916	2869	2823	2777	2732	2687	2642	2598	2554	2511	2468	58
59	2963	2916	2869	2822	2776	2731	2686	2641	2597	2553	2510	2467	59
60	2962	2915	2868	2821	2775	2730	2685	2640	2596	2553	2510	2467	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 1° 42′	h. m. 1° 43′	h. m. 1° 44′	h. m. 1° 45′	h. m. 1° 46′	h. m. 1° 47′	h. m. 1° 48′	h. m. 1° 49′	h. m. 1° 50′	h. m. 1° 51′	h. m. 1° 52′	h. m. 1° 53′	s. ″
0	2467	2424	2382	2341	2300	2259	2218	2178	2139	2099	2061	2022	0
1	2466	2424	2382	2340	2299	2258	2218	2178	2138	2099	2060	2021	1
2	2465	2423	2381	2339	2298	2258	2217	2177	2137	2098	2059	2021	2
3	2465	2422	2380	2339	2298	2257	2216	2176	2137	2098	2059	2020	3
4	2464	2422	2380	2338	2297	2256	2216	2176	2136	2097	2058	2019	4
5	2463	2421	2379	2337	2296	2256	2215	2175	2136	2096	2057	2019	5
6	2462	2420	2378	2337	2296	2255	2214	2174	2135	2096	2057	2018	6
7	2462	2419	2378	2336	2295	2254	2214	2174	2134	2095	2056	2017	7
8	2461	2419	2377	2335	2294	2253	2213	2173	2134	2094	2055	2017	8
9	2460	2418	2376	2335	2294	2253	2212	2172	2133	2094	2055	2016	9
10	2460	2417	2375	2334	2293	2252	2212	2172	2132	2093	2054	2016	10
11	2459	2417	2375	2333	2292	2251	2211	2171	2132	2092	2053	2015	11
12	2458	2416	2374	2333	2291	2251	2210	2170	2131	2092	2053	2014	12
13	2458	2415	2373	2332	2291	2250	2210	2170	2130	2091	2052	2014	13
14	2457	2415	2373	2331	2290	2249	2209	2169	2130	2090	2052	2013	14
15	2456	2414	2372	2331	2289	2249	2208	2169	2129	2090	2051	2012	15
16	2455	2413	2371	2330	2289	2248	2208	2168	2128	2089	2050	2012	16
17	2455	2412	2371	2329	2288	2247	2207	2167	2128	2088	2050	2011	17
18	2454	2412	2370	2328	2287	2247	2206	2167	2127	2088	2049	2010	18
19	2453	2411	2369	2328	2287	2246	2206	2166	2126	2087	2048	2010	19
20	2453	2410	2368	2327	2286	2245	2205	2165	2126	2086	2048	2009	20
21	2452	2410	2368	2326	2285	2245	2204	2165	2125	2086	2047	2009	21
22	2451	2409	2367	2326	2285	2244	2204	2164	2124	2085	2046	2008	22
23	2450	2408	2366	2325	2284	2243	2203	2163	2124	2085	2046	2007	23
24	2450	2408	2366	2324	2283	2243	2202	2163	2123	2084	2045	2007	24
25	2449	2407	2365	2324	2283	2242	2202	2162	2122	2083	2044	2006	25
26	2448	2406	2364	2323	2282	2241	2201	2161	2122	2083	2044	2005	26
27	2448	2405	2364	2322	2281	2241	2200	2161	2121	2082	2043	2005	27
28	2447	2405	2363	2322	2281	2240	2200	2160	2120	2081	2042	2004	28
29	2446	2404	2362	2321	2280	2239	2199	2159	2120	2081	2042	2003	29
30	2445	2403	2362	2320	2279	2239	2198	2159	2119	2080	2041	2003	30
31	2445	2403	2361	2320	2279	2238	2198	2158	2118	2079	2041	2002	31
32	2444	2402	2360	2319	2278	2237	2197	2157	2118	2079	2040	2001	32
33	2443	2401	2359	2318	2277	2237	2196	2157	2117	2078	2039	2001	33
34	2443	2401	2359	2317	2277	2236	2196	2156	2116	2077	2039	2000	34
35	2442	2400	2358	2317	2276	2235	2195	2155	2116	2077	2038	2000	35
36	2441	2399	2357	2316	2275	2235	2194	2155	2115	2076	2037	1999	36
37	2441	2398	2357	2315	2274	2234	2194	2154	2115	2075	2037	1998	37
38	2440	2398	2356	2315	2274	2233	2193	2153	2114	2075	2036	1998	38
39	2439	2397	2355	2314	2273	2233	2192	2153	2113	2074	2035	1997	39
40	2438	2396	2355	2313	2272	2232	2192	2152	2113	2073	2035	1996	40
41	2438	2396	2354	2313	2272	2231	2191	2151	2112	2073	2034	1996	41
42	2437	2395	2353	2312	2271	2231	2190	2151	2111	2072	2033	1995	42
43	2436	2394	2353	2311	2270	2230	2190	2150	2111	2072	2033	1994	43
44	2436	2394	2352	2311	2270	2229	2189	2149	2110	2071	2032	1994	44
45	2435	2393	2351	2310	2269	2229	2188	2149	2109	2070	2032	1993	45
46	2434	2392	2350	2309	2268	2228	2188	2148	2109	2070	2031	1993	46
47	2433	2391	2350	2309	2268	2227	2187	2147	2108	2069	2030	1992	47
48	2433	2391	2349	2308	2267	2227	2186	2147	2107	2068	2030	1991	48
49	2432	2390	2348	2307	2266	2226	2186	2146	2107	2068	2029	1991	49
50	2431	2389	2348	2307	2266	2225	2185	2145	2106	2067	2028	1990	50
51	2431	2389	2347	2306	2265	2225	2184	2145	2105	2066	2028	1989	51
52	2430	2388	2346	2305	2264	2224	2184	2144	2105	2066	2027	1989	52
53	2429	2387	2346	2304	2264	2223	2183	2143	2104	2065	2026	1988	53
54	2429	2387	2345	2304	2263	2223	2182	2143	2103	2064	2026	1987	54
55	2428	2386	2344	2303	2262	2222	2182	2142	2103	2064	2025	1987	55
56	2427	2385	2344	2302	2262	2221	2181	2141	2102	2063	2025	1986	56
57	2426	2384	2343	2302	2261	2220	2180	2141	2101	2062	2024	1986	57
58	2426	2384	2342	2301	2260	2220	2180	2140	2101	2062	2023	1985	58
59	2425	2383	2342	2300	2260	2219	2179	2139	2100	2061	2023	1984	59
60	2424	2382	2341	2300	2259	2218	2178	2139	2099	2061	2022	1984	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 1° 54′	h. m. 1° 55′	h. m. 1° 56′	h. m. 1° 57′	h. m. 1° 58′	h. m. 1° 59′	h. m. 2° 0′	h. m. 2° 1′	h. m. 2° 2′	h. m. 2° 3′	h. m. 2° 4′	s. ″
0	1984	1946	1908	1871	1834	1797	1761	1725	1689	1654	1619	0
1	1983	1945	1908	1870	1833	1797	1760	1724	1689	1653	1618	1
2	1982	1944	1907	1870	1833	1796	1760	1724	1688	1652	1617	2
3	1982	1944	1906	1869	1832	1795	1759	1723	1687	1652	1617	3
4	1981	1943	1906	1868	1831	1795	1759	1722	1687	1651	1616	4
5	1981	1943	1905	1868	1831	1794	1758	1722	1686	1651	1616	5
6	1980	1942	1904	1867	1830	1794	1757	1721	1686	1650	1615	6
7	1979	1941	1904	1867	1830	1793	1757	1721	1685	1650	1614	7
8	1979	1941	1903	1866	1829	1792	1756	1720	1684	1649	1614	8
9	1978	1940	1903	1865	1828	1792	1755	1719	1684	1648	1613	9
10	1977	1939	1902	1865	1828	1791	1755	1719	1683	1648	1613	10
11	1977	1939	1901	1864	1827	1791	1754	1718	1683	1647	1612	11
12	1976	1938	1901	1863	1827	1790	1754	1718	1682	1647	1612	12
13	1975	1938	1900	1863	1826	1789	1753	1717	1681	1646	1611	13
14	1975	1937	1899	1862	1825	1789	1752	1717	1681	1645	1610	14
15	1974	1936	1899	1862	1825	1788	1752	1716	1680	1645	1610	15
16	1974	1936	1898	1861	1824	1788	1751	1715	1680	1644	1609	16
17	1973	1935	1898	1860	1823	1787	1751	1715	1679	1644	1609	17
18	1972	1934	1897	1860	1823	1786	1750	1714	1678	1643	1608	18
19	1972	1934	1896	1859	1822	1786	1749	1714	1678	1643	1607	19
20	1971	1933	1896	1859	1822	1785	1749	1713	1677	1642	1607	20
21	1970	1933	1895	1858	1821	1785	1748	1712	1677	1641	1606	21
22	1970	1932	1894	1857	1820	1784	1748	1712	1676	1641	1606	22
23	1969	1931	1894	1857	1820	1783	1747	1711	1676	1640	1605	23
24	1968	1931	1893	1856	1819	1783	1746	1711	1675	1640	1605	24
25	1968	1930	1893	1855	1819	1782	1746	1710	1675	1639	1604	25
26	1967	1929	1892	1855	1818	1781	1745	1709	1674	1638	1603	26
27	1967	1929	1891	1854	1817	1781	1745	1709	1673	1638	1603	27
28	1966	1928	1891	1854	1817	1780	1744	1708	1673	1637	1602	28
29	1965	1928	1890	1853	1816	1780	1743	1708	1672	1637	1602	29
30	1965	1927	1889	1852	1816	1779	1743	1707	1671	1636	1601	30
31	1964	1926	1889	1852	1815	1778	1742	1706	1671	1635	1600	31
32	1963	1926	1888	1851	1814	1778	1742	1706	1670	1635	1600	32
33	1963	1925	1888	1850	1814	1777	1741	1705	1670	1634	1599	33
34	1962	1924	1887	1850	1813	1777	1740	1705	1669	1634	1599	34
35	1962	1924	1886	1849	1812	1776	1740	1704	1668	1633	1598	35
36	1961	1923	1886	1849	1812	1775	1739	1703	1668	1633	1598	36
37	1960	1923	1885	1848	1811	1775	1739	1703	1667	1632	1597	37
38	1960	1922	1884	1847	1811	1774	1738	1702	1667	1631	1596	38
39	1959	1921	1884	1847	1810	1774	1737	1702	1666	1631	1596	39
40	1958	1921	1883	1846	1809	1773	1737	1701	1665	1630	1595	40
41	1958	1920	1883	1846	1809	1772	1736	1700	1665	1630	1595	41
42	1957	1919	1882	1845	1808	1772	1736	1700	1664	1629	1594	42
43	1956	1919	1881	1844	1808	1771	1735	1699	1664	1628	1593	43
44	1956	1918	1881	1844	1807	1771	1734	1699	1663	1628	1593	44
45	1955	1918	1880	1843	1806	1770	1734	1698	1663	1627	1592	45
46	1955	1917	1880	1843	1806	1769	1733	1697	1662	1627	1592	46
47	1954	1916	1879	1842	1805	1769	1733	1697	1661	1626	1591	47
48	1953	1916	1878	1841	1805	1768	1732	1696	1661	1626	1591	48
49	1953	1915	1878	1841	1804	1768	1731	1696	1660	1625	1590	49
50	1952	1914	1877	1840	1803	1767	1731	1695	1660	1624	1589	50
51	1951	1914	1876	1839	1803	1766	1730	1694	1659	1624	1589	51
52	1951	1913	1876	1839	1802	1766	1730	1694	1658	1623	1588	52
53	1950	1913	1875	1838	1802	1765	1729	1693	1658	1623	1588	53
54	1950	1912	1875	1838	1801	1765	1728	1693	1657	1622	1587	54
55	1949	1911	1874	1837	1800	1764	1728	1692	1657	1621	1587	55
56	1948	1911	1873	1836	1800	1763	1727	1692	1656	1621	1586	56
57	1948	1910	1873	1836	1799	1763	1727	1691	1655	1620	1585	57
58	1947	1909	1872	1835	1798	1762	1726	1690	1655	1620	1585	58
59	1946	1909	1871	1835	1798	1762	1725	1690	1654	1619	1584	59
60	1946	1908	1871	1834	1797	1761	1725	1689	1654	1619	1584	60

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 2° 5′	h. m. 2° 6′	h. m. 2° 7′	h. m. 2° 8′	h. m. 2° 9′	h. m. 2° 10′	h. m. 2° 11′	h. m. 2° 12′	h. m. 2° 13′	h. m. 2° 14′	h. m. 2° 15′	s. ″
0	1584	1549	1515	1481	1447	1413	1380	1347	1314	1282	1249	0
1	1583	1548	1514	1480	1446	1413	1379	1346	1314	1281	1249	1
2	1582	1548	1514	1479	1446	1412	1379	1346	1313	1281	1248	2
3	1582	1547	1513	1479	1445	1412	1378	1345	1313	1280	1248	3
4	1581	1547	1512	1478	1445	1411	1378	1345	1312	1280	1247	4
5	1581	1546	1512	1478	1444	1411	1377	1344	1311	1279	1247	5
6	1580	1546	1511	1477	1443	1410	1377	1344	1311	1278	1246	6
7	1580	1545	1511	1477	1443	1409	1376	1343	1310	1278	1246	7
8	1579	1544	1510	1476	1442	1409	1376	1343	1310	1277	1245	8
9	1578	1544	1510	1476	1442	1408	1375	1342	1309	1277	1245	9
10	1578	1543	1509	1475	1441	1408	1374	1342	1309	1276	1244	10
11	1577	1543	1508	1474	1441	1407	1374	1341	1308	1276	1243	11
12	1577	1542	1508	1474	1440	1407	1373	1340	1308	1275	1243	12
13	1576	1542	1507	1473	1440	1406	1373	1340	1307	1275	1242	13
14	1576	1541	1507	1473	1439	1406	1372	1339	1307	1274	1242	14
15	1575	1540	1506	1472	1438	1405	1372	1339	1306	1274	1241	15
16	1574	1540	1506	1472	1438	1404	1371	1338	1306	1273	1241	16
17	1574	1539	1505	1471	1437	1404	1371	1338	1305	1273	1240	17
18	1573	1539	1504	1470	1437	1403	1370	1337	1304	1272	1240	18
19	1573	1538	1504	1470	1436	1403	1370	1337	1304	1271	1239	19
20	1572	1538	1503	1469	1436	1402	1369	1336	1303	1271	1239	20
21	1571	1537	1503	1469	1435	1402	1368	1335	1303	1270	1238	21
22	1571	1536	1502	1468	1435	1401	1368	1335	1302	1270	1238	22
23	1570	1536	1502	1468	1434	1401	1367	1334	1302	1269	1237	23
24	1570	1535	1501	1467	1433	1400	1367	1334	1301	1269	1237	24
25	1569	1535	1500	1467	1433	1399	1366	1333	1301	1268	1236	25
26	1569	1534	1500	1466	1432	1399	1366	1333	1300	1268	1235	26
27	1568	1534	1499	1465	1432	1398	1365	1332	1300	1267	1235	27
28	1567	1533	1499	1465	1431	1398	1365	1332	1299	1267	1234	28
29	1567	1532	1498	1464	1431	1397	1364	1331	1298	1266	1234	29
30	1566	1532	1498	1464	1430	1397	1363	1331	1298	1266	1233	30
31	1566	1531	1497	1463	1429	1396	1363	1330	1297	1265	1233	31
32	1565	1531	1496	1463	1429	1396	1362	1329	1297	1264	1232	32
33	1565	1530	1496	1462	1428	1395	1362	1329	1296	1264	1232	33
34	1564	1530	1495	1461	1428	1394	1361	1328	1296	1263	1231	34
35	1563	1529	1495	1461	1427	1394	1361	1328	1295	1263	1231	35
36	1563	1528	1494	1460	1427	1393	1360	1327	1295	1262	1230	36
37	1562	1528	1494	1460	1426	1393	1360	1327	1294	1262	1230	37
38	1562	1527	1493	1459	1426	1392	1359	1326	1294	1261	1229	38
39	1561	1527	1493	1459	1425	1392	1359	1326	1293	1261	1229	39
40	1561	1526	1492	1458	1424	1391	1358	1325	1292	1260	1228	40
41	1560	1526	1491	1458	1424	1391	1357	1325	1292	1260	1227	41
42	1559	1525	1491	1457	1423	1390	1357	1324	1291	1259	1227	42
43	1559	1524	1490	1456	1423	1389	1356	1323	1291	1259	1226	43
44	1558	1524	1490	1456	1422	1389	1356	1323	1290	1258	1226	44
45	1558	1523	1489	1455	1422	1388	1355	1322	1290	1257	1225	45
46	1557	1523	1489	1455	1421	1388	1355	1322	1289	1257	1225	46
47	1556	1522	1488	1454	1421	1387	1354	1321	1289	1256	1224	47
48	1556	1522	1487	1454	1420	1387	1354	1321	1288	1256	1223	48
49	1555	1521	1487	1453	1419	1386	1353	1320	1288	1255	1223	49
50	1555	1520	1486	1452	1419	1386	1352	1320	1287	1255	1223	50
51	1554	1520	1486	1452	1418	1385	1352	1319	1287	1254	1222	51
52	1554	1519	1485	1451	1418	1384	1351	1319	1286	1254	1222	52
53	1553	1519	1485	1451	1417	1384	1351	1318	1285	1253	1221	53
54	1552	1518	1484	1450	1417	1383	1350	1317	1285	1253	1221	54
55	1552	1518	1483	1450	1416	1383	1350	1317	1284	1252	1220	55
56	1551	1517	1483	1449	1416	1382	1349	1316	1284	1252	1219	56
57	1551	1516	1482	1449	1415	1382	1349	1316	1283	1251	1219	57
58	1550	1516	1482	1448	1414	1381	1348	1315	1283	1250	1218	58
59	1550	1515	1481	1447	1414	1381	1348	1315	1282	1250	1218	59
60	1549	1515	1481	1447	1413	1380	1347	1314	1282	1249	1217	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m 2° 16′	h. m. 2° 17′	h. m. 2° 18′	h. m. 2° 19′	h. m. 2° 20′	h. m. 2° 21′	h. m. 2° 22′	h. m. 2° 23′	h. m. 2° 24′	h. m. 2° 25′	h. m. 2° 26′	s. ″
0	1217	1186	1154	1123	1091	1061	1030	0999	0969	0939	0909	0
1	1217	1185	1153	1122	1091	1060	1029	0999	0969	0939	0909	1
2	1216	1184	1153	1122	1090	1060	1029	0998	0968	0938	0908	2
3	1216	1184	1152	1121	1090	1059	1028	0998	0968	0938	0908	3
4	1215	1183	1152	1120	1089	1058	1028	0997	0967	0937	0907	4
5	1215	1183	1151	1120	1089	1058	1027	0997	0967	0937	0907	5
6	1214	1182	1151	1119	1088	1057	1027	0996	0966	0936	0906	6
7	1214	1182	1150	1119	1088	1057	1026	0996	0966	0936	0906	7
8	1213	1181	1150	1118	1087	1056	1026	0995	0965	0935	0905	8
9	1213	1181	1149	1118	1087	1056	1025	0995	0965	0935	0905	9
10	1212	1180	1149	1117	1086	1055	1025	0994	0964	0934	0904	10
11	1211	1180	1148	1117	1086	1055	1024	0994	0964	0934	0904	11
12	1211	1179	1148	1116	1085	1054	1024	0993	0963	0933	0903	12
13	1210	1179	1147	1116	1085	1054	1023	0993	0963	0933	0903	13
14	1210	1178	1147	1115	1084	1053	1023	0992	0962	0932	0902	14
15	1209	1178	1146	1115	1084	1053	1022	0992	0962	0932	0902	15
16	1209	1177	1146	1114	1083	1052	1022	0991	0961	0931	0901	16
17	1208	1177	1145	1114	1083	1052	1021	0991	0961	0931	0901	17
18	1208	1176	1145	1113	1082	1051	1021	0990	0960	0930	0900	18
19	1207	1175	1144	1113	1082	1051	1020	0990	0960	0930	0900	19
20	1207	1175	1143	1112	1081	1050	1020	0989	0959	0929	0899	20
21	1206	1174	1143	1112	1081	1050	1019	0989	0959	0929	0899	21
22	1206	1174	1142	1111	1080	1049	1019	0988	0958	0928	0898	22
23	1205	1173	1142	1111	1080	1049	1018	0988	0958	0928	0898	23
24	1205	1173	1141	1110	1079	1048	1018	0987	0957	0927	0897	24
25	1204	1172	1141	1110	1079	1048	1017	0987	0957	0927	0897	25
26	1204	1172	1140	1109	1078	1047	1017	0986	0956	0926	0896	26
27	1203	1171	1140	1109	1078	1047	1016	0986	0956	0926	0896	27
28	1202	1171	1139	1108	1077	1046	1016	0985	0955	0925	0895	28
29	1202	1170	1139	1108	1076	1046	1015	0985	0955	0925	0895	29
30	1201	1170	1138	1107	1076	1045	1015	0984	0954	0924	0894	30
31	1201	1169	1138	1106	1075	1045	1014	0984	0954	0924	0894	31
32	1200	1169	1137	1106	1075	1044	1014	0983	0953	0923	0893	32
33	1200	1168	1137	1105	1074	1044	1013	0983	0953	0923	0893	33
34	1199	1168	1136	1105	1074	1043	1013	0982	0952	0922	0892	34
35	1199	1167	1136	1104	1073	1043	1012	0982	0952	0922	0892	35
36	1198	1167	1135	1104	1073	1042	1012	0981	0951	0921	0891	36
37	1198	1166	1135	1103	1072	1042	1011	0981	0951	0921	0891	37
38	1197	1165	1134	1103	1072	1041	1011	0980	0950	0920	0890	38
39	1197	1165	1134	1102	1071	1041	1010	0980	0950	0920	0890	39
40	1196	1164	1133	1102	1071	1040	1009	0979	0949	0919	0889	40
41	1196	1164	1132	1101	1070	1040	1009	0979	0949	0919	0889	41
42	1195	1163	1132	1101	1070	1039	1008	0978	0948	0918	0888	42
43	1195	1163	1131	1100	1069	1039	1008	0978	0948	0918	0888	43
44	1194	1162	1131	1100	1069	1038	1007	0977	0947	0917	0887	44
45	1193	1162	1130	1099	1068	1037	1007	0977	0947	0917	0887	45
46	1193	1161	1130	1099	1068	1037	1006	0976	0946	0916	0886	46
47	1192	1161	1129	1098	1067	1036	1006	0976	0946	0916	0886	47
48	1192	1160	1129	1098	1067	1036	1005	0975	0945	0915	0885	48
49	1191	1160	1128	1097	1066	1035	1005	0975	0945	0915	0885	49
50	1191	1159	1128	1097	1066	1035	1004	0974	0944	0914	0884	50
51	1190	1159	1127	1096	1065	1034	1004	0974	0944	0914	0884	51
52	1190	1158	1127	1096	1065	1034	1003	0973	0943	0913	0883	52
53	1189	1158	1126	1095	1064	1033	1003	0973	0943	0913	0883	53
54	1189	1157	1126	1095	1064	1033	1002	0972	0942	0912	0882	54
55	1188	1157	1125	1094	1063	1032	1002	0972	0942	0912	0882	55
56	1188	1156	1125	1094	1063	1032	1001	0971	0941	0911	0882	56
57	1187	1156	1124	1093	1062	1031	1001	0971	0941	0911	0881	57
58	1187	1155	1124	1092	1062	1031	1000	0970	0940	0910	0881	58
59	1186	1154	1123	1092	1061	1030	1000	0970	0940	0910	0880	59
60	1186	1154	1123	1091	1061	1030	0999	0969	0939	0909	0880	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 2° 27′	h. m. 2° 28′	h. m. 2° 29′	h. m. 2° 30′	h. m. 2° 31′	h. m. 2° 32′	h. m. 2° 33′	h. m. 2° 34′	h. m. 2° 35′	h. m. 2° 36′	h. m. 2° 37′	s. ″
0	0880	0850	0821	0792	0763	0734	0706	0678	0649	0621	0594	0
1	0879	0850	0820	0791	0762	0734	0705	0677	0649	0621	0593	1
2	0879	0849	0820	0791	0762	0733	0705	0677	0648	0621	0593	2
3	0878	0849	0819	0790	0762	0733	0704	0676	0648	0620	0592	3
4	0878	0848	0819	0790	0761	0732	0704	0676	0648	0620	0592	4
5	0877	0848	0818	0789	0761	0732	0703	0675	0647	0619	0591	5
6	0877	0847	0818	0789	0760	0731	0703	0675	0647	0619	0591	6
7	0876	0847	0817	0788	0760	0731	0703	0674	0646	0618	0591	7
8	0876	0846	0817	0788	0759	0730	0702	0674	0646	0618	0590	8
9	0875	0846	0816	0787	0759	0730	0702	0673	0645	0617	0590	9
10	0875	0845	0816	0787	0758	0730	0701	0673	0645	0617	0589	10
11	0874	0845	0816	0787	0758	0729	0701	0672	0644	0616	0589	11
12	0874	0844	0815	0786	0757	0729	0700	0672	0644	0616	0588	12
13	0873	0844	0815	0786	0757	0728	0700	0671	0643	0615	0588	13
14	0873	0843	0814	0785	0756	0728	0699	0671	0643	0615	0587	14
15	0872	0843	0814	0785	0756	0727	0699	0670	0642	0615	0587	15
16	0872	0842	0813	0784	0755	0727	0698	0670	0642	0614	0586	16
17	0871	0842	0813	0784	0755	0726	0698	0670	0641	0614	0586	17
18	0871	0841	0812	0783	0754	0726	0697	0669	0641	0613	0585	18
19	0870	0841	0812	0783	0754	0725	0697	0669	0641	0613	0585	19
20	0870	0840	0811	0782	0753	0725	0696	0668	0640	0612	0585	20
21	0869	0840	0811	0782	0753	0724	0696	0668	0640	0612	0584	21
22	0869	0839	0810	0781	0752	0724	0695	0667	0639	0611	0584	22
23	0868	0839	0810	0781	0752	0723	0695	0667	0639	0611	0583	23
24	0868	0838	0809	0780	0751	0723	0694	0666	0638	0610	0583	24
25	0867	0838	0809	0780	0751	0722	0694	0666	0638	0610	0582	25
26	0867	0837	0808	0779	0751	0722	0694	0665	0637	0609	0582	26
27	0866	0837	0808	0779	0750	0721	0693	0665	0637	0609	0581	27
28	0866	0836	0807	0778	0750	0721	0693	0664	0636	0609	0581	28
29	0865	0836	0807	0778	0749	0721	0692	0664	0636	0608	0580	29
30	0865	0835	0806	0777	0749	0720	0692	0663	0635	0608	0580	30
31	0864	0835	0806	0777	0748	0720	0691	0663	0635	0607	0579	31
32	0864	0834	0805	0776	0748	0719	0691	0663	0634	0607	0579	32
33	0863	0834	0805	0776	0747	0719	0690	0662	0634	0606	0579	33
34	0863	0834	0804	0775	0747	0718	0690	0662	0634	0606	0578	34
35	0862	0833	0804	0775	0746	0718	0689	0661	0633	0605	0578	35
36	0862	0833	0803	0774	0746	0717	0689	0661	0633	0605	0577	36
37	0861	0832	0803	0774	0745	0717	0688	0660	0632	0604	0577	37
38	0861	0832	0802	0774	0745	0716	0688	0660	0632	0604	0576	38
39	0860	0831	0802	0773	0744	0716	0687	0659	0631	0603	0576	39
40	0860	0831	0801	0773	0744	0715	0687	0659	0631	0603	0575	40
41	0859	0830	0801	0772	0743	0715	0686	0658	0630	0602	0575	41
42	0859	0830	0801	0772	0743	0714	0686	0658	0630	0602	0574	42
43	0858	0829	0800	0771	0742	0714	0686	0657	0629	0602	0574	43
44	0858	0829	0800	0771	0742	0713	0685	0657	0629	0601	0573	44
45	0857	0828	0799	0770	0741	0713	0685	0656	0628	0601	0573	45
46	0857	0828	0799	0770	0741	0712	0684	0656	0628	0600	0573	46
47	0856	0827	0798	0769	0740	0712	0684	0655	0628	0600	0572	47
48	0856	0827	0798	0769	0740	0711	0683	0655	0627	0599	0572	48
49	0855	0826	0797	0768	0740	0711	0683	0655	0627	0599	0571	49
50	0855	0826	0797	0768	0739	0711	0682	0654	0626	0598	0571	50
51	0855	0825	0796	0767	0739	0710	0682	0654	0626	0598	0570	51
52	0854	0825	0796	0767	0738	0710	0681	0653	0625	0597	0570	52
53	0854	0824	0795	0766	0738	0709	0681	0653	0625	0597	0569	53
54	0853	0824	0795	0766	0737	0709	0680	0652	0624	0596	0569	54
55	0853	0823	0794	0765	0737	0708	0680	0652	0624	0596	0568	55
56	0852	0823	0794	0765	0736	0708	0679	0651	0623	0596	0568	56
57	0852	0822	0793	0764	0736	0707	0679	0651	0623	0595	0568	57
58	0851	0822	0793	0764	0735	0707	0678	0650	0622	0595	0567	58
59	0851	0821	0792	0763	0735	0706	0678	0650	0622	0594	0567	59
60	0850	0821	0792	0763	0734	0706	0678	0649	0621	0594	0566	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 2° 38′	h. m. 2° 39′	h. m. 2° 40′	h. m. 2° 41′	h. m. 2° 42′	h. m. 2° 43′	h. m. 2° 44′	h. m. 2° 45′	h. m. 2° 46′	h. m. 2° 47′	h. m. 2° 48′	s. ″
0	0566	0539	0512	0484	0458	0431	0404	0378	0352	0326	0300	0
1	0566	0538	0511	0484	0457	0430	0404	0377	0351	0325	0299	1
2	0565	0538	0511	0484	0457	0430	0403	0377	0351	0325	0299	2
3	0565	0537	0510	0483	0456	0430	0403	0377	0350	0324	0298	3
4	0564	0537	0510	0483	0456	0429	0403	0376	0350	0324	0298	4
5	0564	0536	0509	0482	0455	0429	0402	0376	0349	0323	0297	5
6	0563	0536	0509	0482	0455	0428	0402	0375	0349	0323	0297	6
7	0563	0536	0508	0481	0454	0428	0401	0375	0349	0323	0297	7
8	0562	0535	0508	0481	0454	0427	0401	0374	0348	0322	0296	8
9	0562	0535	0507	0480	0454	0427	0400	0374	0348	0322	0296	9
10	0562	0534	0507	0480	0453	0426	0400	0374	0347	0321	0295	10
11	0561	0534	0507	0480	0453	0426	0399	0373	0347	0321	0295	11
12	0561	0533	0506	0479	0452	0426	0399	0373	0346	0320	0294	12
13	0560	0533	0506	0479	0452	0425	0399	0372	0346	0320	0294	13
14	0560	0532	0505	0478	0451	0425	0398	0372	0346	0319	0294	14
15	0559	0532	0505	0478	0451	0424	0398	0371	0345	0319	0293	15
16	0559	0531	0504	0477	0450	0424	0397	0371	0345	0319	0293	16
17	0558	0531	0504	0477	0450	0423	0397	0370	0344	0318	0292	17
18	0558	0531	0503	0476	0450	0423	0396	0370	0344	0318	0292	18
19	0557	0530	0503	0476	0449	0422	0396	0370	0343	0317	0291	19
20	0557	0530	0502	0475	0449	0422	0395	0369	0343	0317	0291	20
21	0557	0529	0502	0475	0448	0422	0395	0369	0342	0316	0291	21
22	0556	0529	0502	0475	0448	0421	0395	0368	0342	0316	0290	22
23	0556	0528	0501	0474	0447	0421	0394	0368	0342	0316	0290	23
24	0555	0528	0501	0474	0447	0420	0394	0367	0341	0315	0289	24
25	0555	0527	0500	0473	0446	0420	0393	0367	0341	0315	0289	25
26	0554	0527	0500	0473	0446	0419	0393	0366	0340	0314	0288	26
27	0554	0526	0499	0472	0446	0419	0392	0366	0340	0314	0288	27
28	0553	0526	0499	0472	0445	0418	0392	0366	0339	0313	0288	28
29	0553	0526	0498	0471	0445	0418	0392	0365	0339	0313	0287	29
30	0552	0525	0498	0471	0444	0418	0391	0365	0339	0313	0287	30
31	0552	0525	0498	0471	0444	0417	0391	0364	0338	0312	0286	31
32	0552	0524	0497	0470	0443	0417	0390	0364	0338	0312	0286	32
33	0551	0524	0497	0470	0443	0416	0390	0363	0337	0311	0285	33
34	0551	0523	0496	0469	0442	0416	0389	0363	0337	0311	0285	34
35	0550	0523	0496	0469	0442	0415	0389	0363	0336	0310	0285	35
36	0550	0522	0495	0468	0442	0415	0388	0362	0336	0310	0284	36
37	0549	0522	0495	0468	0441	0414	0388	0362	0336	0310	0284	37
38	0549	0521	0494	0467	0441	0414	0388	0361	0335	0309	0283	38
39	0548	0521	0494	0467	0440	0414	0387	0361	0335	0309	0283	39
40	0548	0521	0493	0466	0440	0413	0387	0360	0334	0308	0282	40
41	0547	0520	0493	0466	0439	0413	0386	0360	0334	0308	0282	41
42	0547	0520	0493	0466	0439	0412	0386	0359	0333	0307	0282	42
43	0546	0519	0492	0465	0438	0412	0385	0359	0333	0307	0281	43
44	0546	0519	0492	0465	0438	0411	0385	0359	0333	0307	0281	44
45	0546	0518	0491	0464	0438	0411	0384	0358	0332	0306	0280	45
46	0545	0518	0491	0464	0437	0410	0384	0358	0332	0306	0280	46
47	0545	0517	0490	0463	0437	0410	0384	0357	0331	0305	0279	47
48	0544	0517	0490	0463	0436	0410	0383	0357	0331	0305	0279	48
49	0544	0517	0489	0462	0436	0409	0383	0356	0330	0304	0279	49
50	0543	0516	0489	0462	0435	0409	0382	0356	0330	0304	0278	50
51	0543	0516	0489	0462	0435	0408	0382	0356	0329	0304	0278	51
52	0542	0515	0488	0461	0434	0408	0381	0355	0329	0303	0277	52
53	0542	0515	0488	0461	0434	0407	0381	0355	0329	0303	0277	53
54	0541	0514	0487	0460	0434	0407	0381	0354	0328	0302	0276	54
55	0541	0514	0487	0460	0433	0406	0380	0354	0328	0302	0276	55
56	0541	0513	0486	0459	0433	0406	0380	0353	0327	0301	0276	56
57	0540	0513	0486	0459	0432	0406	0379	0353	0327	0301	0275	57
58	0540	0512	0485	0458	0432	0405	0379	0353	0326	0300	0275	58
59	0539	0512	0485	0458	0431	0405	0378	0352	0326	0300	0274	59
60	0539	0512	0484	0458	0431	0404	0378	0352	0326	0300	0274	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 2° 49′	h. m. 2° 50′	h. m. 2° 51′	h. m. 2° 52′	h. m. 2° 53′	h. m. 2° 54′	h. m. 2° 55′	h. m. 2° 56′	h. m. 2° 57′	h. m. 2° 58′	h. m. 2° 59′	s. ″
0	0274	0248	0223	0197	0172	0147	0122	0098	0073	0049	0024	0
1	0273	0248	0222	0197	0172	0147	0122	0097	0073	0048	0024	1
2	0273	0247	0222	0197	0171	0146	0122	0097	0072	0048	0023	2
3	0273	0247	0221	0196	0171	0146	0121	0096	0072	0047	0023	3
4	0272	0247	0221	0196	0171	0146	0121	0096	0071	0047	0023	4
5	0272	0246	0221	0195	0170	0145	0120	0096	0071	0046	0022	5
6	0271	0246	0220	0195	0170	0145	0120	0095	0071	0046	0022	6
7	0271	0245	0220	0194	0169	0144	0119	0095	0070	0046	0021	7
8	0270	0245	0219	0194	0169	0144	0119	0094	0070	0045	0021	8
9	0270	0244	0219	0194	0169	0143	0119	0094	0069	0045	0021	9
10	0270	0244	0219	0193	0168	0143	0118	0093	0069	0044	0020	10
11	0269	0244	0218	0193	0168	0143	0118	0093	0068	0044	0020	11
12	0269	0243	0218	0192	0167	0142	0117	0093	0068	0044	0019	12
13	0268	0243	0217	0192	0167	0142	0117	0092	0068	0043	0019	13
14	0268	0242	0217	0192	0166	0141	0117	0092	0067	0043	0019	14
15	0267	0242	0216	0191	0166	0141	0116	0091	0067	0042	0018	15
16	0267	0241	0216	0191	0166	0141	0116	0091	0066	0042	0018	16
17	0267	0241	0216	0190	0165	0140	0115	0091	0066	0042	0017	17
18	0266	0241	0215	0190	0165	0140	0115	0090	0066	0041	0017	18
19	0266	0240	0215	0189	0164	0139	0114	0090	0065	0041	0017	19
20	0265	0240	0214	0189	0164	0139	0114	0089	0065	0040	0016	20
21	0265	0239	0214	0189	0163	0139	0114	0089	0064	0040	0016	21
22	0264	0239	0213	0188	0163	0138	0113	0089	0064	0040	0015	22
23	0264	0238	0213	0188	0163	0138	0113	0088	0064	0039	0015	23
24	0264	0238	0213	0187	0162	0137	0112	0088	0063	0039	0015	24
25	0263	0238	0212	0187	0162	0137	0112	0087	0063	0038	0014	25
26	0263	0237	0212	0187	0161	0136	0112	0087	0062	0038	0014	26
27	0262	0237	0211	0186	0161	0136	0111	0087	0062	0038	0013	27
28	0262	0236	0211	0186	0161	0136	0111	0086	0062	0037	0013	28
29	0261	0236	0211	0185	0160	0135	0110	0086	0061	0037	0012	29
30	0261	0235	0210	0185	0160	0135	0110	0085	0061	0036	0012	30
31	0261	0235	0210	0184	0159	0134	0110	0085	0060	0036	0012	31
32	0260	0235	0209	0184	0159	0134	0109	0084	0060	0036	0011	32
33	0260	0234	0209	0184	0158	0134	0109	0084	0060	0035	0011	33
34	0259	0234	0208	0183	0158	0133	0108	0084	0059	0035	0010	34
35	0259	0233	0208	0183	0158	0133	0108	0083	0059	0034	0010	35
36	0258	0233	0208	0182	0157	0132	0107	0083	0058	0034	0010	36
37	0258	0233	0207	0182	0157	0132	0107	0082	0058	0034	0009	37
38	0258	0232	0207	0181	0156	0131	0107	0082	0057	0033	0009	38
39	0257	0232	0206	0181	0156	0131	0106	0082	0057	0033	0008	39
40	0257	0231	0206	0181	0156	0131	0106	0081	0057	0032	0008	40
41	0256	0231	0205	0180	0155	0130	0105	0081	0056	0032	0008	41
42	0256	0230	0205	0180	0155	0130	0105	0080	0056	0031	0007	42
43	0255	0230	0205	0179	0154	0129	0105	0080	0055	0031	0007	43
44	0255	0230	0204	0179	0154	0129	0104	0080	0055	0031	0006	44
45	0255	0229	0204	0179	0153	0129	0104	0079	0055	0030	0006	45
46	0254	0229	0203	0178	0153	0128	0103	0079	0054	0030	0006	46
47	0254	0228	0203	0178	0153	0128	0103	0078	0054	0029	0005	47
48	0253	0228	0202	0177	0152	0127	0103	0078	0053	0029	0005	48
49	0253	0227	0202	0177	0152	0127	0102	0077	0053	0029	0004	49
50	0252	0227	0202	0176	0151	0126	0102	0077	0053	0028	0004	50
51	0252	0227	0201	0176	0151	0126	0101	0077	0052	0028	0004	51
52	0252	0226	0201	0176	0151	0126	0101	0076	0052	0027	0003	52
53	0251	0226	0200	0175	0150	0125	0100	0076	0051	0027	0003	53
54	0251	0225	0200	0175	0150	0125	0100	0075	0051	0027	0002	54
55	0250	0225	0200	0174	0149	0124	0100	0075	0051	0026	0002	55
56	0250	0224	0199	0174	0149	0124	0099	0075	0050	0026	0002	56
57	0250	0224	0199	0174	0148	0124	0099	0074	0050	0025	0001	57
58	0249	0224	0198	0173	0148	0123	0098	0074	0049	0025	0001	58
59	0249	0223	0198	0173	0148	0123	0098	0073	0049	0025	0000	59
60	0248	0223	0197	0172	0147	0122	0098	0073	0049	0024	0000	60

TABLE XXXV.

To correct the Apparent Distance of the MOON from the SUN or a STAR, for the Effects of Parallax and Refraction.

Par. in Alt. or Dist.	APPARENT DISTANCE.																				
	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	30°
M	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
8	3	3	3	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1
10	5	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2
11	6	5	5	5	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2	2
12	7	6	6	5	5	5	4	4	4	4	3	3	3	3	3	3	3	2	2	2	2
13	8	8	7	6	6	6	5	5	5	4	4	4	4	3	3	3	3	3	3	3	3
14	10	9	8	7	7	6	6	6	5	5	5	4	4	4	4	4	4	3	3	3	3
15	11	10	9	9	8	7	7	6	6	6	5	5	5	5	4	4	4	4	4	4	3
16	13	11	11	10	9	8	8	7	7	6	6	6	6	5	5	5	5	4	4	4	4
17	14	13	12	11	10	9	9	8	8	7	7	7	6	6	6	5	5	5	5	5	4
18	16	15	13	12	11	11	10	9	9	8	8	7	7	7	6	6	6	6	5	5	5
19	18	16	15	14	13	12	11	10	10	9	9	8	8	7	7	7	6	6	6	6	5
20	20	18	16	15	14	13	12	11	11	10	10	9	9	8	8	7	7	7	7	6	6
21	22	20	18	17	15	14	13	13	12	11	11	10	10	9	9	8	8	8	7	7	7
22	24	22	20	18	17	16	15	14	13	12	12	11	10	10	9	9	9	8	8	8	7
23	26	24	22	20	19	17	16	15	14	13	13	12	11	11	10	10	9	9	9	8	8
24	28	26	24	22	20	19	18	16	15	15	14	13	12	12	11	11	10	10	9	9	9
25	31	28	26	24	22	20	19	18	17	16	15	14	13	13	12	12	11	11	10	10	9
26	33	30	28	26	24	22	21	19	18	17	16	15	15	14	13	13	12	12	11	11	10
27	36	33	30	28	26	24	22	21	20	18	17	17	16	15	14	13	13	12	12	11	11
28	39	35	32	30	27	26	24	22	21	20	19	18	17	16	15	15	14	13	13	12	12
29	42	38	35	32	29	27	26	24	23	21	20	19	18	17	16	16	15	14	14	13	13
30	45	40	37	34	31	29	27	26	24	23	22	20	19	19	18	17	16	15	15	14	14
31	48	43	39	36	34	31	29	27	26	24	23	22	21	20	19	18	17	16	16	15	15
32	51	46	42	39	36	33	31	29	27	26	25	23	22	21	20	19	18	18	17	16	15
33	54	49	45	41	38	35	33	31	29	28	26	25	24	22	21	20	19	19	18	17	16
34	57	52	47	44	40	38	35	33	31	29	28	26	25	24	23	22	21	20	19	18	17
35	61	55	50	46	43	40	37	35	33	31	29	28	26	25	24	23	22	21	20	19	19
36	64	58	53	49	45	42	39	37	35	33	31	29	28	27	25	24	23	22	21	20	20
37	68	61	56	52	48	45	42	39	37	35	33	31	30	28	27	26	24	23	22	22	21
38	71	65	59	55	51	47	44	41	39	37	35	33	31	30	28	27	26	25	24	23	22
39	75	68	62	57	53	50	46	43	41	39	36	35	33	31	30	28	27	26	25	24	23
40	79	72	66	60	56	52	49	46	43	41	38	36	35	33	31	30	29	27	26	25	24
41	83	75	69	63	59	55	51	48	45	43	40	38	36	35	33	31	30	29	28	26	25
42	87	79	72	67	62	57	54	50	47	45	42	40	38	36	35	33	32	30	29	28	27
43	91	83	76	70	65	60	56	53	50	47	44	42	40	38	36	35	33	32	30	29	28
44	96	87	79	73	68	63	59	55	52	49	46	44	42	40	38	36	35	33	32	30	29
45	100	91	83	76	71	66	62	58	54	51	49	46	44	42	40	38	36	35	33	32	31
46	105	95	87	80	74	69	64	60	57	54	51	48	46	43	41	40	38	36	35	33	32
47	109	99	91	83	77	72	67	63	59	56	53	50	48	45	43	41	40	38	36	35	33
48	114	103	94	87	81	75	70	66	62	58	55	52	50	47	45	43	41	39	38	36	35
49	119	108	98	91	84	78	73	68	64	61	58	55	52	49	47	45	43	41	39	38	36
50	124	112	103	94	87	81	76	71	67	63	60	57	54	51	49	47	45	43	41	39	38
51	128	117	107	98	91	85	79	74	70	66	62	59	56	53	51	49	47	45	43	41	39
52	134	121	111	102	95	88	82	77	73	68	65	61	58	56	53	51	48	46	44	43	41
53	139	126	115	106	98	91	85	80	75	71	67	64	61	58	55	53	50	48	46	44	42
54	144	131	120	110	102	95	89	83	78	74	70	66	63	60	57	55	52	50	48	46	44
55	149	136	124	114	106	98	92	86	81	77	72	69	65	62	59	57	54	52	50	48	46
56	155	141	129	118	110	102	95	89	84	79	75	71	68	64	61	59	56	54	51	49	47
57	160	146	133	123	114	106	99	93	87	82	78	74	70	67	64	61	58	56	53	51	49
58	166	151	138	127	118	109	102	96	90	85	81	76	73	69	66	63	60	58	55	53	51
59	172	156	143	131	122	113	106	99	93	88	83	79	75	72	68	65	62	60	57	55	53
60	178	161	148	136	126	117	109	103	97	91	86	82	78	74	71	67	64	62	59	57	54
61	184	167	152	140	130	121	113	106	100	94	89	85	80	76	73	70	67	64	61	59	56
62	190	172	158	145	134	125	117	110	103	97	92	87	83	79	75	72	69	66	63	60	58
	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	30°

TABLE XXXV.

To correct the Apparent Distance of the MOON from the SUN or a STAR, for the Effects of Parallax and Refraction.

Par. in Alt. or Dist.	APPARENT DISTANCE.																				
	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	50°	51°
M	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1
13	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
14	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1
15	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2
16	4	4	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2
17	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2
18	5	5	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	2	2	2
19	5	5	5	5	4	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3
20	6	6	5	5	5	5	5	4	4	4	4	4	4	4	3	3	3	3	3	3	3
21	6	6	6	6	5	5	5	5	5	5	4	4	4	4	4	4	4	3	3	3	3
22	7	7	7	6	6	6	6	5	5	5	5	5	5	4	4	4	4	4	4	4	3
23	8	7	7	7	7	6	6	6	6	6	5	5	5	5	5	4	4	4	4	4	4
24	8	8	8	7	7	7	7	6	6	6	6	6	5	5	5	5	5	5	4	4	4
25	9	9	8	8	8	8	7	7	7	6	6	6	6	6	5	5	5	5	5	5	4
26	10	9	9	9	8	8	8	8	7	7	7	7	6	6	6	6	6	5	5	5	5
27	11	10	10	9	9	9	8	8	8	8	7	7	7	7	6	6	6	6	6	5	5
28	11	11	11	10	10	9	9	9	8	8	8	8	7	7	7	7	6	6	6	6	6
29	12	12	11	11	10	10	10	9	9	9	8	8	8	8	7	7	7	7	6	6	6
30	13	13	12	12	11	11	10	10	10	9	9	9	8	8	8	8	7	7	7	7	6
31	14	13	13	12	12	12	11	11	10	10	10	9	9	9	8	8	8	8	7	7	7
32	15	14	14	13	13	12	12	11	11	11	10	10	10	9	9	9	8	8	8	7	7
33	16	15	15	14	14	13	13	12	12	11	11	11	10	10	10	9	9	9	8	8	8
34	17	16	16	15	14	14	13	13	12	12	12	11	11	10	10	10	9	9	9	8	8
35	18	17	16	16	15	15	14	14	13	13	12	12	11	11	11	10	10	10	9	9	9
36	19	18	17	17	16	16	15	14	14	13	13	13	12	12	11	11	11	10	10	9	9
37	20	19	18	18	17	16	16	15	15	14	14	13	13	12	12	12	11	11	10	10	10
38	21	20	19	19	18	17	17	16	16	15	14	14	14	13	13	12	12	11	11	11	10
39	22	21	20	20	19	18	18	17	16	16	15	15	14	14	13	13	12	12	12	11	11
40	23	22	21	21	20	19	19	18	17	17	16	16	15	14	14	13	13	13	12	12	11
41	24	23	23	22	21	20	19	19	18	17	17	16	16	15	15	14	14	13	13	12	12
42	26	25	24	23	22	21	20	20	19	18	18	17	17	16	15	15	14	14	13	13	12
43	27	26	25	24	23	22	21	21	20	19	19	18	17	17	16	16	15	15	14	14	13
44	28	27	26	25	24	23	22	22	21	20	19	19	18	17	17	16	16	15	15	14	14
45	29	28	27	26	25	24	23	23	22	21	20	20	19	18	18	17	16	16	15	15	14
46	31	30	28	27	26	25	25	24	23	22	21	21	20	19	18	18	17	17	16	15	15
47	32	31	30	29	28	27	26	25	24	23	22	21	21	20	19	19	18	17	17	16	16
48	33	32	31	30	29	28	27	26	25	24	23	22	22	21	20	19	19	18	17	17	16
49	35	34	32	31	30	29	28	27	26	25	24	23	22	22	21	20	20	19	18	18	17
50	36	35	34	32	31	30	29	28	27	26	25	24	23	23	22	21	20	20	19	18	18
51	38	36	35	34	32	31	30	29	28	27	26	25	24	24	23	22	21	20	20	19	18
52	39	38	36	35	34	32	31	30	29	28	27	26	25	24	24	23	22	21	21	20	19
53	41	39	38	36	35	34	33	31	30	29	28	27	26	25	25	24	23	22	21	21	20
54	42	41	39	38	36	35	34	33	31	30	29	28	27	26	25	25	24	23	22	21	21
55	44	42	41	39	38	36	35	34	33	31	30	29	28	27	26	25	25	24	23	22	21
56	46	44	42	41	39	38	36	35	34	33	31	30	29	28	27	26	26	25	24	23	22
57	47	45	44	42	40	39	38	36	35	34	33	31	30	29	28	27	26	26	25	24	23
58	49	47	45	44	42	40	39	38	36	35	34	33	31	30	29	28	27	26	26	25	24
59	51	49	47	45	43	42	40	39	38	36	35	34	33	31	30	29	28	27	26	25	25
60	52	50	48	47	45	43	42	40	39	37	36	35	34	33	31	30	29	28	27	26	25
61	54	52	50	48	46	45	43	42	40	39	37	36	35	34	32	31	30	29	28	27	26
62	56	54	52	50	48	46	45	43	41	40	39	37	36	35	34	32	31	30	29	28	27
F F	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	50°	51°

TABLE XXXV.

To correct the Apparent Distance of the MOON from the SUN or a STAR, for the Effects of Parallax and Refraction.

Par. in Alt. or Dist.	APPARENT DISTANCE.																				
	52°	53°	54°	55°	56°	57°	58°	59°	60°	65°	70°	75°	80°	85°	90°	95°	100°	105°	110°	115°	120°
M	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	20	20	20	20	20
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	20	20	20	20	20
10	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	20	20	20	20	20	19
11	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	20	20	20	20	20	19
12	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	20	20	20	20	19	19
13	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	20	20	20	19	19	19
14	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	20	20	20	19	19	19
15	2	1	1	1	1	1	1	1	1	1	1	1	0	0	0	20	20	19	19	19	19
16	2	2	2	2	2	1	1	1	1	1	1	1	0	0	0	20	20	19	19	19	19
17	2	2	2	2	2	2	2	2	1	1	1	1	0	0	0	20	20	19	19	19	19
18	2	2	2	2	2	2	2	2	2	1	1	1	0	0	0	20	20	19	19	19	18
19	2	2	2	2	2	2	2	2	2	1	1	1	1	0	0	20	19	19	19	19	18
20	3	3	3	2	2	2	2	2	2	2	1	1	1	0	0	20	19	19	19	18	18
21	3	3	3	3	3	2	2	2	2	2	1	1	1	0	0	20	19	19	19	18	18
22	3	3	3	3	3	3	3	3	2	2	2	1	1	0	0	20	19	19	18	18	18
23	4	3	3	3	3	3	3	3	3	2	2	1	1	0	0	20	19	19	18	18	17
24	4	4	4	4	3	3	3	3	3	2	2	1	1	0	0	20	19	19	18	18	17
25	4	4	4	4	4	4	3	3	3	3	2	1	1	0	0	20	19	19	18	17	17
26	5	4	4	4	4	4	4	4	3	3	2	2	1	1	0	19	19	18	18	17	17
27	5	5	5	4	4	4	4	4	4	3	2	2	1	1	0	19	19	18	18	17	16
28	5	5	5	5	5	4	4	4	4	3	2	2	1	1	0	19	19	18	18	17	16
29	6	6	5	5	5	5	5	4	4	3	3	2	1	1	0	19	19	18	17	17	16
30	6	6	6	5	5	5	5	5	5	4	3	2	1	1	0	19	19	18	17	16	15
31	7	6	6	6	6	5	5	5	5	4	3	2	1	1	0	19	19	18	17	16	15
32	7	7	6	6	6	6	6	5	5	4	3	2	2	1	0	19	18	18	17	16	15
33	7	7	7	7	6	6	6	6	5	4	3	3	2	1	0	19	18	17	17	16	15
34	8	8	7	7	7	7	6	6	6	5	4	3	2	1	0	19	18	17	16	15	14
35	8	8	8	7	7	7	7	6	6	5	4	3	2	1	0	19	18	17	16	15	14
36	9	9	8	8	8	7	7	7	7	5	4	3	2	1	0	19	18	17	16	15	13
37	9	9	9	8	8	8	7	7	7	6	4	3	2	1	0	19	18	17	16	14	13
38	10	9	9	9	8	8	8	8	7	6	5	3	2	1	0	19	18	17	15	14	13
39	10	10	10	9	9	9	8	8	8	6	5	4	2	1	0	19	18	16	15	14	12
40	11	11	10	10	9	9	9	8	8	7	5	4	2	1	0	19	18	16	15	13	12
41	11	11	11	10	10	10	9	9	8	7	5	4	3	1	0	19	17	16	15	13	12
42	12	12	11	11	10	10	10	9	9	7	6	4	3	1	0	19	17	16	14	13	11
43	13	12	12	11	11	10	10	10	9	8	6	4	3	1	0	19	17	16	14	12	11
44	13	13	12	12	11	11	11	10	10	8	6	5	3	1	0	19	17	15	14	12	10
45	14	13	13	12	12	11	11	11	10	8	6	5	3	2	0	18	17	15	14	12	10
46	14	14	13	13	12	12	12	11	11	9	7	5	3	2	0	18	17	15	13	11	9
47	15	15	14	13	13	13	12	12	11	9	7	5	3	2	0	18	17	15	13	11	9
48	16	15	15	14	14	13	13	12	12	9	7	5	4	2	0	18	16	15	13	11	8
49	16	16	15	15	14	14	13	13	12	10	8	6	4	2	0	18	16	14	12	10	8
50	17	16	16	15	15	14	14	13	13	10	8	6	4	2	0	18	16	14	12	10	7
51	18	17	16	16	15	15	14	14	13	11	8	6	4	2	0	18	16	14	12	9	7
52	18	18	17	17	16	15	15	14	14	11	9	6	4	2	0	18	16	14	11	9	6
53	19	18	18	17	17	16	15	15	14	11	9	7	4	2	0	18	16	13	11	9	6
54	20	19	18	18	17	17	16	15	15	12	9	7	4	2	0	18	16	13	11	8	5
55	21	20	19	18	18	17	16	16	15	12	10	7	5	2	0	18	15	13	10	8	5
56	21	21	20	19	18	18	17	16	16	13	10	7	5	2	0	18	15	13	10	7	4
57	22	21	21	20	19	18	18	17	16	13	10	8	5	2	0	18	15	12	10	7	4
58	23	22	21	21	20	19	18	18	17	14	11	8	5	3	0	17	15	12	9	6	3
59	24	23	22	21	20	20	19	18	18	14	11	8	5	3	0	17	15	12	9	6	2
60	25	24	23	22	21	20	20	19	18	15	11	8	6	3	0	17	14	12	9	5	2
61	25	24	24	23	22	21	20	20	19	15	12	9	6	3	0	17	14	11	8	5	1
62	26	25	24	23	23	22	21	20	19	16	12	9	6	3	0	17	14	11	8	4	1
	52°	53°	54°	55°	56°	57°	58°	59°	60°	65°	70°	75°	80°	85°	90°	95°	100°	105°	110°	115°	120°

TABLE XXXVI.

EQUATIONS TO EQUAL ALTITUDES.

First Part.

Interval.		Sun's Longitude.											
		O Sign.						I Sign.					
		0°	5°	10°	15°	20°	25°	0°	5°	10°	15°	20°	25°
		—	—	—	—	—	—	—	—	—	—	—	—
h.	m.	s	s	s	s	s	s	s	s	s	s	s	s
3	0	15.47	15.38	15.19	14.90	14.51	14.02	13.44	12.76	11.99	11.12	10.16	9.12
3	20	15.57	15.48	15.28	14.99	14.60	14.10	13.53	12.84	12.06	11.19	10.22	9.17
3	40	15.68	15.58	15.38	15.09	14.69	14.20	13.62	12.93	12.14	11.27	10.29	9.23
4	0	15.79	15.70	15.50	15.20	14.80	14.31	13.72	13.02	12.23	11.35	10.37	9.30
4	20	15.93	15.83	15.62	15.32	14.92	14.42	13.83	13.13	12.33	11.44	10.46	9.38
4	40	16.08	15.97	15.77	15.46	15.05	14.55	13.95	13.25	12.44	11.54	10.55	9.46
5	0	16.22	16.12	15.91	15.61	15.20	14.69	14.08	13.37	12.56	11.65	10.65	9.55
5	20	16.38	16.28	16.08	15.77	15.35	14.84	14.22	13.51	12.69	11.77	10.75	9.65
5	40	16.56	16.46	16.25	15.94	15.52	15.00	14.37	13.65	12.83	11.90	10.87	9.76
6	0	16.75	16.65	16.44	16.12	15.70	15.17	14.54	13.81	12.97	12.04	11.00	9.87
6	20	16.95	16.85	16.64	16.32	15.89	15.36	14.72	13.98	13.14	12.19	11.14	9.99
6	40	17.18	17.08	16.86	16.54	16.10	15.56	14.92	14.17	13.31	12.35	11.28	10.12
7	0	17.42	17.32	17.10	16.78	16.32	15.78	15.13	14.36	13.49	12.52	11.44	10.26
7	20	17.67	17.57	17.35	17.01	16.56	16.01	15.35	14.57	13.69	12.70	11.61	10.41
7	40	17.94	17.84	17.62	17.27	16.82	16.26	15.57	14.80	13.90	12.90	11.79	10.57
8	0	18.23	18.13	17.90	17.55	17.09	16.52	15.84	15.04	14.13	13.11	11.98	10.74
8	20	18.54	18.44	18.20	17.85	17.38	16.80	16.11	15.29	14.37	13.33	12.18	10.93
8	40	18.87	18.77	18.53	18.17	17.69	17.10	16.40	15.56	14.63	13.57	12.40	11.12
9	0	19.22	19.12	18.88	18.51	18.02	17.42	16.70	15.86	14.89	13.82	12.63	11.33
9	20	19.61	19.49	19.25	18.87	18.37	17.76	17.03	16.17	15.18	14.09	12.88	11.55
9	40	20.01	19.89	19.65	19.26	18.75	18.12	17.38	16.50	15.50	14.38	13.14	11.79
10	0	20.44	20.32	20.06	19.67	19.16	18.51	17.75	16.85	15.83	14.69	13.42	12.04
10	20	20.91	20.77	20.51	20.11	19.59	18.93	18.15	17.23	16.19	15.02	13.72	12.31
10	40	21.38	21.25	20.99	20.58	20.05	19.37	18.57	17.63	16.57	15.37	14.04	12.59
11	0	21.91	21.77	21.50	21.08	20.54	19.84	19.02	18.06	16.97	15.74	14.38	12.90
11	20	22.46	22.32	22.04	21.62	21.06	20.34	19.50	18.52	17.40	16.14	14.75	13.23
11	40	23.05	22.91	22.62	22.19	21.61	20.88	20.02	19.01	17.86	16.57	15.14	13.58
12	0	23.69	23.55	23.25	22.80	22.21	21.43	20.57	19.53	18.35	17.03	15.56	13.96

Second Part.

			+	+	+	+	+	+	+	+	+	+	+
h.	m.	s	s	s	s	s	s	s	s	s	s	s	s
3	0	0.00	0.49	0.97	1.43	1.84	2.21	2.52	2.77	2.93	3.01	3.01	2.91
3	20	0.00	0.49	0.96	1.41	1.82	2.18	2.49	2.73	2.89	2.97	2.97	2 87
3	40	0.00	0.48	0.95	1.39	1.79	2.15	2.45	2.69	2.85	2.93	2.93	2.83
4	0	0.00	0.47	0.93	1.36	1.76	2.12	2.41	2.65	2.81	2.89	2.88	2.77
4	20	0.00	0.46	0.91	1.34	1.73	2.08	2.38	2.60	2.76	2.83	2.83	2.73
4	40	0.00	0.45	0.90	1.31	1.70	2.04	2.32	2.55	2.70	2.77	2.77	2.68
5	0	0.00	0.44	0.88	1.27	1.66	1.99	2.27	2.49	2.65	2.71	2.71	2.61
5	20	0.00	0.43	0.85	1.25	1.62	1.94	2.21	2.41	2.57	2.64	2.64	2.55
5	40	0.00	0.42	0.83	1.22	1.58	1.89	2.15	2.36	2.50	2.57	2.57	2.48
6	0	0.00	0.41	0.81	1.18	1.53	1.83	2.09	2.29	2.43	2.50	2.49	2.41
6	20	0.00	0.40	0.78	1.14	1.48	1.77	2.02	2.22	2.35	2.42	2.41	2.33
6	40	0.00	0.38	0.75	1.10	1.43	1.71	1.95	2.14	2.26	2.33	2.32	2.24
7	0	0.00	0.37	0.72	1.06	1.37	1.64	1.87	2.05	2.18	2.24	2.23	2.15
7	20	0.00	0.35	0.69	1.01	1.31	1.57	1.79	1.96	2.08	2.14	2.13	2.06
7	40	0.00	0.33	0.66	0.96	1.24	1.49	1.70	1.86	1.98	2.03	2.03	1.97
8	0	0.00	0.31	0.62	0.91	1.17	1.41	1.61	1.76	1.87	1.92	1.92	1.85
8	20	0.00	0.30	0.58	0.85	1.10	1.32	1.51	1.65	1.75	1.80	1.80	1.74
8	40	0.00	0 27	0.54	0.79	1.03	1.23	1.41	1.54	1.65	1.68	1.68	1.62
9	0	0.00	0.25	0.50	0.73	0.97	1.14	1.30	1.42	1.51	1.55	1.55	1.49
9	20	0.00	0.23	0.46	0.67	0.87	1.04	1.19	1.29	1.37	1.41	1.41	1.36
9	40	0.00	0.21	0.41	0.60	0.78	0.93	1.06	1.16	1.23	1.27	1.27	1.22
10	0	0.00	0.18	0.37	0.53	0.68	0.82	0.93	1.02	1.08	1.12	1.11	1.07
10	20	0.00	0.16	0.31	0.45	0.58	0.70	0.80	0.87	0.92	0.95	0 95	0.91
10	40	0.00	0.13	0.25	0.37	0.48	0.58	0.66	0.71	0.76	0.78	0 78	0.75
11	0	0.00	0.10	0.19	0.29	0.37	0.44	0.51	0.55	0.59	0.60	0.60	0.58
11	20	0.00	0.07	0.13	0.20	0.25	0.30	0.35	0.38	0.41	0.41	0.41	0.40
11	40	0.00	0.04	0.07	0.10	0.13	0.16	0.18	0.19	0.21	0.21	0.21	0.20
12	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE XXXVI.

EQUATIONS TO EQUAL ALTITUDES.

First Part.

Interval.		Sun's Longitude.											
		II Signs.						III Signs.					
		0°	5°	10°	15°	20°	25°	0°	5°	10°	15°	20°	25°
		−	−	−	−	−	−		+	+	+	+	+
h.	m.	s	s	s	s	s	s	s	s	s	s	s	s
3	0	7.99	6.78	5.51	4.18	2.81	1.41	0.00	1.41	2.81	4.17	5.49	6.75
3	20	8.04	6.82	5.55	4.21	2.83	1.42	0.00	1.42	2.83	4.20	5.52	6.79
3	40	8.09	6.87	5.59	4.24	2.85	1.43	0.00	1.43	2.85	4.23	5.56	6.84
4	0	8.15	6.92	5.63	4.27	2.87	1.44	0.00	1.44	2.87	4.26	5.60	6.89
4	20	8.22	6.98	5.67	4.30	2.90	1.46	0.00	1.45	2.89	4.29	5.65	6.95
4	40	8.29	7.04	5.72	4.34	2.92	1.47	0.00	1.47	2.92	4.33	5.70	7.01
5	0	8.38	7.11	5.77	4.38	2.95	1.48	0.00	1.48	2.95	4.37	5.75	7.07
5	20	8.46	7.18	5.84	4.43	2.98	1.50	0.00	1.49	2.98	4.42	5.81	7.14
5	40	8.55	7.26	5.90	4.48	3.01	1.51	0.00	1.51	3.01	4.47	5.89	7.22
6	0	8.65	7.35	5.97	4.53	3.05	1.53	0.00	1.53	3.04	4.52	5.94	7.31
6	20	8.76	7.44	6.04	4.59	3.09	1.55	0.00	1.55	3.08	4.57	6.02	7.40
6	40	8.87	7.54	6.12	4.64	3.13	1.57	0.00	1.57	3.12	4.63	6.10	7.50
7	0	8.99	7.64	6.21	4.71	3.17	1.59	0.00	1.59	3.16	4.70	6.18	7.60
7	20	9.12	7.75	6.30	4.77	3.22	1.62	0.00	1.61	3.21	4.77	6.27	7.71
7	40	9.26	7.87	6.40	4.85	3.27	1.64	0.00	1.64	3.26	4.84	6.37	7.83
8	0	9.41	8.00	6.50	4.93	3.32	1.67	0.00	1.66	3.31	4.92	6.47	7.96
8	20	9.57	8.14	6.61	5.01	3.37	1.70	0.00	1.69	3.37	5.01	6.58	8.10
8	40	9.74	8.27	6.72	5.10	3.43	1.73	0.00	1.72	3.43	5.09	6.71	8.24
9	0	9.93	8.43	6.85	5.20	3.50	1.76	0.00	1.76	3.50	5.19	6.82	8.39
9	20	10.12	8.60	6.99	5.30	3.57	1.79	0.00	1.79	3.56	5.29	6.96	8.56
9	40	10.33	8.77	7.13	5.41	3.64	1.83	0.00	1.83	3.63	5.40	7.10	8.73
10	0	10.55	8.96	7.28	5.53	3.72	1.87	0.00	1.87	3.71	5.51	7.25	8.92
10	20	10.78	9.16	7.44	5.65	3.80	1.91	0.00	1.91	3.79	5.63	7.41	9.12
10	40	11.03	9.37	7.62	5.78	3.89	1.95	0.00	1.95	3.88	5.77	7.59	9.33
11	0	11.30	9.60	7.80	5.92	3.98	2.00	0.00	2.00	3.97	5.91	7.77	9.56
11	20	11.59	9.85	8.00	6.07	4.08	2.05	0.00	2.05	4.07	6.06	7.97	9.80
11	40	11.90	10.11	8.21	6.23	4.19	2.10	0.00	2.10	4.18	6.22	8.17	10.06
12	0	12.23	10.39	8.44	6.41	4.31	2.16	0.00	2.16	4.30	6.39	8.41	10.34

Second Part.

		+	+	+	+	+	+		−	−	−	−	−
h.	m.	s	s	s	s	s	s	s	s	s	s	s	s
3	0	2.71	2.42	2.06	1.61	1.11	0.57	0.00	0.56	1.11	1.61	2.05	2.41
3	20	2.68	2.39	2.03	1.59	1.10	0.56	0.00	0.56	1.10	1.59	2.02	2.38
3	40	2.64	2.36	2.00	1.57	1.08	0.55	0.00	0.55	1.08	1.57	1.99	2.35
4	0	2.60	2.32	1.97	1.54	1.06	0.54	0.00	0.54	1.06	1.54	1.97	2.31
4	20	2.55	2.28	1.93	1.51	1.04	0.53	0.00	0.53	1.04	1.51	1.92	2.27
4	40	2.50	2.23	1.89	1.48	1.02	0.52	0.00	0.52	1.02	1.48	1.88	2.22
5	0	2.44	2.18	1.85	1.45	1.00	0.51	0.00	0.51	1.00	1.44	1.84	2.17
5	20	2.38	2.13	1.80	1.41	0.98	0.50	0.00	0.49	0.97	1.41	1.80	2.12
5	40	2.31	2.07	1.75	1.37	0.95	0.48	0.00	0.48	0.94	1.37	1.74	2.06
6	0	2.24	2.00	1.70	1.33	0.92	0.47	0.00	0.47	0.91	1.33	1.70	2.00
6	20	2.17	1.94	1.65	1.29	0.89	0.45	0.00	0.45	0.88	1.29	1.64	1.93
6	40	2.09	1.87	1.59	1.24	0.86	0.44	0.00	0.44	0.85	1.24	1.58	1.86
7	0	2.01	1.80	1.53	1.20	0.83	0.42	0.00	0.42	0.82	1.19	1.52	1.79
7	20	1.92	1.72	1.46	1.14	0.79	0.40	0.00	0.40	0.78	1.14	1.45	1.71
7	40	1.83	1.64	1.39	1.09	0.75	0.38	0.00	0.38	0.75	1.08	1.38	1.63
8	0	1.73	1.55	1.31	1.03	0.71	0.36	0.00	0.36	0.71	1.02	1.31	1.54
8	20	1.62	1.45	1.23	0.97	0.67	0.34	0.00	0.34	0.67	0.96	1.23	1.44
8	40	1.51	1.35	1.15	0.90	0.62	0.32	0.00	0.31	0.62	0.90	1.14	1.34
9	0	1.39	1.25	1.06	0.83	0.57	0.29	0.00	0.29	0.57	0.83	1.05	1.24
9	20	1.27	1.13	0.96	0.76	0.52	0.26	0.00	0.26	0.52	0.76	0.96	1.13
9	40	1.14	1.02	0.86	0.68	0.47	0.24	0.00	0.24	0.47	0.68	0.86	1.02
10	0	1.01	0.90	0.76	0.60	0.41	0.21	0.00	0.21	0.41	0.60	0.76	0.90
10	20	0.85	0.77	0.65	0.51	0.36	0.18	0.00	0.18	0.35	0.51	0.65	0.77
10	40	0.70	0.63	0.53	0.42	0.29	0.15	0.00	0.15	0.29	0.42	0.53	0.63
11	0	0.54	0.49	0.41	0.32	0.22	0.11	0.00	0.11	0.22	0.32	0.41	0.48
11	20	0.37	0.33	0.29	0.22	0.15	0.08	0.00	0.08	0.15	0.22	0.28	0.33
11	40	0.19	0.17	0.14	0.11	0.08	0.04	0.00	0.04	0.08	0.11	0.14	0.17
12	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE XXXVI.

EQUATIONS TO EQUAL ALTITUDES.

First Part.

Sun's Longitude.

Interval.		IV Signs.						V Signs.					
		0°	5°	10°	15°	20°	25°	0°	5°	10°	15°	20°	25°
		+	+	+	+	+	+	+	+	+	+	+	+
h.	m.	s	s	s	s	s	s	s	s	s	s	s	s
3	0	7.94	9.06	10.09	11.03	11.89	12.65	13.31	13.88	14.35	14.74	15.03	15.22
3	20	7.99	9.11	10.15	11.10	11.96	12.72	13.40	13.97	14.44	14.83	15.12	15.31
3	40	8.05	9.17	10.22	11.18	12.04	12.81	13.49	14.07	14.54	14.93	15.22	15.41
4	0	8.11	9.24	10.30	11.26	12.13	12.91	13.59	14.18	14.65	15.04	15.34	15.53
4	20	8.18	9.32	10.38	11.35	12.23	13.01	13.70	14.28	14.77	15.16	15.46	15.65
4	40	8.24	9.40	10.47	11.45	12.33	13.12	13.82	14.41	14.90	15.30	15.59	15.79
5	0	8.32	9.49	10.57	11.56	12.45	13.25	13.95	14.54	15.04	15.44	15.74	15.94
5	20	8.41	9.59	10.68	11.68	12.58	13.38	14.09	14.69	15.20	15.60	15.90	16.10
5	40	8.50	9.69	10.80	11.81	12.72	13.53	14.24	14.85	15.37	15.77	16.08	16.28
6	0	8.60	9.80	10.93	11.94	12.86	13.69	14.41	15.03	15.54	15.95	16.27	16.47
6	20	8.71	9.93	11.06	12.09	13.02	13.86	14.59	15.21	15.73	16.15	16.47	16.67
6	40	8.82	10.06	11.20	12.25	13.19	14.04	14.78	15.41	15.94	16.36	16.68	16.89
7	0	8.94	10.20	11.36	12.42	13.38	14.23	14.98	15.62	16.16	16.59	16.91	17.12
7	20	9.07	10.34	11.53	12.60	13.58	14.44	15.20	15.85	16.39	16.84	17.16	17.38
7	40	9.21	10.50	11.70	12.79	13.78	14.67	15.44	16.10	16.64	17.10	17.42	17.64
8	0	9.36	10.68	11.89	13.01	14.01	14.90	15.69	16.36	16.91	17.37	17.70	17.93
8	20	9.52	10.86	12.10	13.22	14.25	15.15	15.96	16.64	17.20	17.67	18.00	18.23
8	40	9.69	11.05	12.31	13.46	14.50	15.42	16.24	16.94	17.51	17.98	18.32	18.56
9	0	9.87	11.26	12.54	13.71	14.77	15.71	16.54	17.26	17.84	18.31	18.67	18.91
9	20	10.06	11.48	12.79	13.98	15.06	16.02	16.87	17.59	18.19	18.67	19.04	19.29
9	40	10.27	11.71	13.05	14.27	15.37	16.35	17.22	17.95	18.56	19.06	19.43	19.68
10	0	10.49	11.96	13.33	14.57	15.70	16.70	17.58	18.34	18.96	19.47	19.84	20.09
10	20	10.73	12.23	13.63	14.90	16.05	17.07	17.98	18.75	19.39	19.90	20.29	20.54
10	40	10.98	12.52	13.94	15.25	16.42	17.47	18.40	19.18	19.84	20.36	20.77	21.02
11	0	11.24	12.82	14.28	15.62	16.82	17.90	18.85	19.64	20.32	20.86	21.26	21.53
11	20	11.53	13.14	14.65	16.01	17.25	18.35	19.32	20.14	20.84	21.39	21.80	22.08
11	40	11.84	13.49	15.04	16.43	17.71	18.84	19.83	20.69	21.39	21.96	22.38	22.66
12	0	12.16	13.86	15.45	16.89	18.19	19.36	20.38	21.25	21.97	22.56	23.00	23.29

Second Part.

		—	—	—	—	—	—	—	—	—	—	—	—
h.	m.	s	s	s	s	s	s	s	s	s	s	s	s
3	0	2.70	2.89	2.99	2.99	2.91	2.74	2.50	2.19	1.82	1.41	0.96	0.49
3	20	2.66	2.85	2.95	2.95	2.87	2.70	2.47	2.16	1.80	1.39	0.95	0.48
3	40	2.62	2.80	2.90	2.91	2.83	2.66	2.43	2.13	1.77	1.37	0.94	0.47
4	0	2.58	2.76	2.85	2.86	2.78	2.62	2.39	2.09	1.74	1.35	0.92	0.47
4	20	2.53	2.71	2.80	2.81	2.73	2.57	2.35	2.05	1.71	1.33	0.90	0.46
4	40	2.48	2.66	2.75	2.75	2.68	2.52	2.30	2.01	1.68	1.30	0.88	0.45
5	0	2.43	2.60	2.69	2.69	2.62	2.47	2.25	1.97	1.64	1.27	0.86	0.44
5	20	2.37	2.54	2.62	2.62	2.55	2.41	2.10	1.92	1.60	1.24	0.84	0.43
5	40	2.30	2.47	2.55	2.55	2.48	2.34	2.13	1.87	1.56	1.21	0.82	0.42
6	0	2.23	2.39	2.47	2.48	2.41	2.27	2.07	1.81	1.51	1.17	0.80	0.41
6	20	2.16	2.31	2.39	2.40	2.33	2.20	2.01	1.75	1.46	1.13	0.78	0.39
6	40	2.08	2.23	2.31	2.31	2.25	2.12	1.93	1.69	1.41	1.09	0.74	0.38
7	0	2.00	2.14	2.22	2.22	2.16	2.04	1.85	1.62	1.35	1.05	0.71	0.36
7	20	1.91	2.05	2.12	2.12	2.06	1.94	1.77	1.55	1.29	1.00	0.68	0.35
7	40	1.82	1.95	2.01	2.02	1.96	1.85	1.68	1.48	1.23	0.95	0.65	0.33
8	0	1.72	1.84	1.90	1.91	1.85	1.75	1.59	1.40	1.16	0.90	0.62	0.31
8	20	1.61	1.73	1.79	1.79	1.74	1.65	1.50	1.31	1.09	0.85	0.58	0.29
8	40	1.50	1.61	1.67	1.67	1.62	1.53	1.40	1.22	1.02	0.79	0.54	0.27
9	0	1.38	1.48	1.54	1.54	1.49	1.41	1.28	1.13	0.94	0.73	0.50	0.25
9	20	1.26	1.35	1.40	1.40	1.36	1.28	1.17	1.03	0.86	0.66	0.45	0.23
9	40	1.13	1.21	1.26	1.26	1.22	1.15	1.05	0.92	0.77	0.59	0.40	0.21
10	0	0.99	1.06	1.11	1.11	1.10	1.01	0.92	0.81	0.68	0.52	0.35	0.18
10	20	0.85	0.91	0.95	0.95	0.92	0.86	0.79	0.69	0.58	0.45	0.31	0.15
10	40	0.70	0.75	0.78	0.78	0.76	0.71	0.65	0.57	0.47	0.37	0.25	0.13
11	0	0.54	0.57	0.60	0.60	0.58	0.55	0.50	0.44	0.36	0.28	0.19	0.10
11	20	0.37	0.40	0.41	0.41	0.39	0.37	0.34	0.30	0.25	0.19	0.13	0.07
11	40	0.19	0.20	0.21	0.21	0.20	0.19	0.17	0.15	0.13	0.10	0.07	0.04
12	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE XXXVI.

EQUATIONS TO EQUAL ALTITUDES.

First Part.

Interval.		Sun's Longitude.											
		VI Signs.						VII Signs.					
		0°	5°	10°	15°	20°	25°	0°	5°	10°	15°	20°	25°
		+	+	+	+	+	+	+	+	+	+	+	+
h.	m.	s	s	s	s	s	s	s	s	s	s	s	s
3	0	15.31	15.30	15.20	14.99	14.69	14.28	13.76	13.14	12.41	11.57	10.62	9.57
3	20	15.41	15.40	15.29	15.08	14.78	14.37	13.85	13.22	12.49	11.64	10.68	9.63
3	40	15.51	15.50	15.39	15.19	14.88	14.46	13.95	13.31	12.57	11.71	10.75	9.69
4	0	15.62	15.61	15.51	15.30	14.99	14.57	14.05	13.41	12.66	11.80	10.83	9.76
4	20	15.75	15.74	15.63	15.42	15.11	14.69	14.16	13.52	12.76	11.90	10.92	9.84
4	40	15.89	15.88	15.77	15.56	15.24	14.82	14.29	13.64	12.87	12.01	11.02	9.93
5	0	16.04	16.03	15.92	15.71	15.39	14.96	14.42	13.77	13.00	12.12	11.13	10.03
5	20	16.21	16.20	16.08	15.87	15.55	15.11	14.57	13.91	13.13	12.24	11.24	10.13
5	40	16.39	16.37	16.26	16.04	15.72	15.28	14.73	14.06	13.27	12.37	11.36	10.24
6	0	16.57	16.56	16.45	16.23	15.90	15.46	14.90	14.22	13.42	12.51	11.49	10.36
6	20	16.78	16.77	16.65	16.43	16.09	15.65	15.08	14.40	13.59	12.67	11.63	10.48
6	40	17.00	16.99	16.87	16.65	16.30	15.86	15.28	14.59	13.77	12.84	11.79	10.63
7	0	17.23	17.22	17.10	16.87	16.53	16.08	15.49	14.79	13.96	13.02	11.96	10.77
7	20	17.48	17.47	17.35	17.12	16.77	16.31	15.72	15.01	14.17	13.21	12.13	10.93
7	40	17.75	17.74	17.62	17.39	17.03	16.56	15.96	15.24	14.39	13.41	12.31	11.09
8	0	18.04	18.03	17.91	17.67	17.31	16.82	16.22	15.49	14.62	13.63	12.51	11.27
8	20	18.35	18.34	18.22	17.97	17.60	17.11	16.49	15.75	14.87	13.86	12.72	11.46
8	40	18.68	18.66	18.54	18.29	17.92	17.42	16.79	16.03	15.14	14.11	12.95	11.67
9	0	19.03	19.01	18.88	18.63	18.25	17.75	17.11	16.33	15.42	14.37	13.20	11.89
9	20	19.40	19.39	19.25	18.99	18.61	18.10	17.44	16.65	15.72	14.65	13.45	12.12
9	40	19.79	19.79	19.65	19.38	18.99	18.47	17.80	16.99	16.04	14.95	13.73	12.38
10	0	20.22	20.21	20.07	19.80	19.40	18.86	18.18	17.35	16.38	15.27	14.03	12.64
10	20	20.67	20.66	20.52	20.24	19.83	19.28	18.58	17.74	16.75	15.61	14.34	12.92
10	40	21.15	21.14	21.00	20.71	20.29	19.73	19.02	18.15	17.14	15.98	14.67	13.22
11	0	21.68	21.66	21.51	21.22	20.79	20.21	19.48	18.60	17.56	16.37	15.03	13.54
11	20	22.22	22.21	22.05	21.76	21.32	20.72	19.98	19.07	18.00	16.78	15.41	13.88
11	40	22.81	22.80	22.64	22.33	21.88	21.27	20.50	19.57	18.48	17.23	15.82	14.25
12	0	23.44	23.42	23.26	22.95	22.48	21.85	21.06	20.11	18.99	17.70	16.25	14.65

Second Part.

		+	+	+	+	+	+	+	+	+	+	+	+
h.	m.	s	s	s	s	s	s	s	s	s	s	s	s
3	0	0.00	0.49	0.97	1.43	1.86	2.25	2.58	2.85	3.04	3.14	3.14	3.05
3	20	0.00	0.48	0.96	1.42	1.84	2.22	2.55	2.81	3.00	3.10	3.10	3.01
3	40	0.00	0.48	0.95	1.40	1.82	2.19	2.51	2.77	2.95	3.05	3.06	2.97
4	0	0.00	0.47	0.93	1.37	1.78	2.15	2.47	2.72	2.90	3.00	3.01	2.92
4	20	0.00	0.46	0.91	1.35	1.75	2.12	2.43	2.67	2.85	2.94	2.95	2.87
4	40	0.00	0.45	0.89	1.32	1.72	2.07	2.38	2.62	2.79	2.88	2.89	2.81
5	0	0.00	0.44	0.87	1.29	1.68	2.03	2.33	2.56	2.73	2.82	2.83	2.75
5	20	0.00	0.43	0.85	1.26	1.64	1.98	2.27	2,50	2.66	2.75	2.76	2.69
5	40	0.00	0.42	0.83	1.22	1.59	1.92	2.21	2.41	2.59	2.68	2.68	2.60
6	0	0.00	0.41	0.81	1.19	1.54	1.86	2.14	2.36	2.53	2.60	2.60	2.52
6	20	0.00	0.39	0.78	1.15	1.49	1.80	2.07	2.28	2.43	2.51	2.52	2.44
6	40	0.00	0.38	0.75	1.11	1.44	1.74	2.00	2.20	2.34	2.42	2.43	2.35
7	0	0.00	0.36	0.72	1.06	1.38	1.67	1.92	2.11	2.25	2.32	2.33	2.26
7	20	0.00	0.35	0.69	1.02	1.32	1.60	1.83	2.02	2.15	2.22	2.23	2.16
7	40	0.00	0.33	0.66	0.97	1.26	1.52	1.74	1.92	2.05	2.11	2.12	2.06
8	0	0.00	0.31	0.62	0.91	1.19	1.44	1.65	1.82	1.94	2.00	2.00	1.95
8	20	0.00	0.29	0.58	0.86	1.12	1.35	1.55	1.71	1.82	1.88	1.88	1.83
8	40	0.00	0.27	0.54	0.80	1.04	1.26	1.44	1.59	1.69	1.75	1.75	1.70
9	0	0.00	0.25	0.50	0.74	0.96	1.16	1.33	1.47	1.56	1.61	1.62	1.57
9	20	0.00	0.23	0.46	0.67	0.87	1.06	1.21	1.34	1.42	1.47	1.47	1.43
9	40	0.00	0.21	0.41	0.60	0.78	0.95	1.09	1.20	1.28	1 32	1.32	1.28
10	0	0.00	0.18	0.36	0.53	0.69	0.83	0.96	1.05	1.12	1.16	1.16	1.13
10	20	0.00	0.15	0.31	0.45	0.59	0.71	0.82	0.90	0.96	0.99	0.99	0.96
10	40	0.00	0.13	0.25	0.37	0.48	0.58	0.67	0.74	0.79	0.81	0.82	0.79
11	0	0.00	0.10	0.19	0.29	0.37	0.45	0.52	0.57	0.61	0.63	0.63	0 61
11	20	0.00	0.07	0.13	0.20	0.26	0.31	0.35	0.39	0.42	0.43	0.43	0.42
11	40	0.00	0.04	0.07	0.10	0.13	0.16	0.18	0.20	0.21	0.22	0.22	0.21
12	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE XXXVI.

EQUATIONS TO EQUAL ALTITUDES.

First Part.

Interval.		Sun's Longitude.											
		VIII Signs.						IX Signs.					
		0°	5°	10°	15°	20°	25°	0°	5°	10°	15°	20°	25°
		+	+	+	+	+	+		—	—	—	—	—
h.	m.	s	s	s	s	s	s	s	s	s	s	s	s
3	0	8.42	7.18	5.85	4.45	3.00	1.51	0.00	1.51	3.00	4.46	5.87	7.20
3	20	8.47	7.22	5.88	4.48	3.02	1.52	0.00	1.52	3.02	4.49	5.90	7.24
3	40	8.53	7.27	5.92	4.51	3.04	1.53	0.00	1.53	3.04	4.52	5.94	7.29
4	0	8.59	7.32	5.97	4.54	3.06	1.54	0.00	1.54	3.07	4.55	5.99	7.35
4	20	8.66	7.38	6.02	4.58	3.09	1.55	0.00	1.55	3.09	4.59	6.04	7.41
4	40	8.74	7.45	6.07	4.62	3.11	1.56	0.00	1.57	3.12	4.63	6.09	7.48
5	0	8.82	7.52	6.13	4.66	3.14	1.58	0.00	1.58	3.15	4.67	6.15	7.55
5	20	8.91	7.59	6.19	4.71	3.18	1.60	0.00	1.60	3.18	4.72	6.21	7.62
5	40	9.01	7.68	6.26	4.76	3.21	1.62	0.00	1.62	3.21	4.77	6.28	7.70
6	0	9.11	7.76	6.33	4.82	3.25	1.64	0.00	1.64	3.25	4.83	6.35	7.79
6	20	9.22	7.86	6.41	4.88	3.29	1.66	0.00	1.66	3.28	4.89	6.43	7.89
6	40	9.34	7.96	6.49	4.94	3.33	1.68	0.00	1.68	3.33	4.95	6.51	8.00
7	0	9.48	8.07	6.58	5.01	3.38	1.70	0.00	1.70	3.38	5.02	6.60	8.11
7	20	9.61	8.19	6.68	5.08	3.43	1.73	0.00	1.73	3.43	5.09	6.70	8.23
7	40	9.76	8.32	6.78	5.16	3.48	1.75	0.00	1.75	3.48	5.17	6.80	8.36
8	0	9.92	8.45	6.89	5.24	3.54	1.78	0.00	1.78	3.54	5.26	6.91	8.49
8	20	10.09	8.59	7.01	5.33	3.60	1.81	0.00	1.81	3.60	5.35	7.03	8.63
8	40	10.27	8.75	7.14	5.43	3.66	1.84	0.00	1.84	3.66	5.44	7.16	8.79
9	0	10.46	8.92	7.27	5.53	3.73	1.88	0.00	1.88	3.73	5.54	7.29	8.95
9	20	10.66	9.09	7.41	5.64	3.80	1.91	0.00	1.92	3.81	5.65	7.43	9.12
9	40	10.88	9.27	7.56	5.76	3.88	1.95	0.00	1.95	3.89	5.77	7.59	9.31
10	0	11.11	9.47	7.72	5.88	3.96	1.99	0.00	1.99	3.97	5.89	7.75	9.51
10	20	11.36	9.68	7.89	6.01	4.05	2.04	0.00	2.04	4.06	6.02	7.92	9.72
10	40	11.63	9.91	8.08	6.15	4.14	2.09	0.00	2.09	4.15	6.17	8.11	9.95
11	0	11.91	10.15	8.28	6.30	4.24	2.14	0.00	2.14	4.25	6.32	8.31	10.19
11	20	12.21	10.41	8.47	6.46	4.35	2.19	0.00	2.19	4.36	6.48	8.52	10.45
11	40	12.54	10.68	8.71	6.63	4.47	2.25	0.00	2.25	4.48	6.65	8.74	10.74
12	0	12.89	10.98	8.96	6.81	4.59	2.31	0.00	2.31	4.60	6.83	8.98	11.02

Second Part.

		+	+	+	+	+	+		—	—	—	—	—
h.	m.	s	s	s	s	s	s	s	s	s	s	s	s
3	0	2.86	2.57	2.18	1.71	1.18	0.60	0.00	0.60	1.18	1.72	2.19	2.58
3	20	2.82	2.53	2.15	1.69	1.17	0.60	0.00	0.60	1.17	1.70	2.16	2.54
3	40	2.78	2.49	2.12	1.67	1.15	0.59	0.00	0.59	1.15	1.67	2.13	2.50
4	0	2.73	2.45	2.08	1.64	1.13	0.58	0.00	0.58	1.13	1.64	2.09	2.46
4	20	2.68	2.41	2.05	1.61	1.11	0.57	0.00	0.57	1.11	1.61	2.05	2.42
4	40	2.63	2.36	2.01	1.58	1.09	0.55	0.00	0.55	1.09	1.57	2.01	2.37
5	0	2.58	2.31	1.96	1.54	1.06	0.54	0.00	0.54	1.06	1.54	1.97	2.32
5	20	2.51	2.25	1.91	1.50	1.04	0.53	0.00	0.53	1.04	1.51	1.92	2.26
5	40	2.44	2.19	1.86	1.46	1.01	0.51	0.00	0.51	1.01	1.47	1.87	2.20
6	0	2.37	2.12	1.81	1.42	0.98	0.50	0.00	0.50	0.98	1.42	1.81	2.13
6	20	2.29	2.05	1.75	1.37	0.95	0.48	0.00	0.48	0.95	1.38	1.75	2.06
6	40	2.21	1.98	1.69	1.32	0.91	0.47	0.00	0.47	0.91	1.33	1.69	1.99
7	0	2.12	1.91	1.62	1.27	0.88	0.45	0.00	0.45	0.89	1.27	1.62	1.91
7	20	2.03	1.82	1.55	1.22	0.84	0.43	0.00	0.43	0.84	1.22	1.55	1.83
7	40	1.93	1.73	1.47	1.16	0.80	0.41	0.00	0.41	0.80	1.16	1.47	1.74
8	0	1.82	1.63	1.39	1.09	0.75	0.38	0.00	0.38	0.75	1.10	1.39	1.64
8	20	1.71	1.53	1.31	1.02	0.71	0.36	0.00	0.36	0.71	1.03	1.31	1.54
8	40	1.59	1.43	1.22	0.96	0.66	0.34	0.00	0.34	0.66	0.96	1.22	1.44
9	0	1.46	1.32	1.12	0.88	0.61	0.31	0.00	0.31	0.61	0.88	1.13	1.33
9	20	1.34	1.20	1.02	0.80	0.55	0.28	0.00	0.28	0.55	0.80	1.03	1.21
9	40	1.20	1.08	0.92	0.72	0.50	0.25	0.00	0.25	0.50	0.72	0.92	1.09
10	0	1.05	0.94	0.81	0.63	0.44	0.22	0.00	0.22	0.44	0.64	0.81	0.95
10	20	0.90	0.81	0.69	0.54	0.37	0.19	0.00	0.19	0.37	0.55	0.69	0.81
10	40	0.74	0.66	0.57	0.44	0.31	0.16	0.00	0.16	0.31	0.45	0.57	0.67
11	0	0.57	0.51	0.44	0.34	0.24	0.12	0.00	0.12	0.24	0.35	0.44	0.51
11	20	0.39	0.35	0.30	0.23	0.16	0.08	0.00	0.08	0.16	0.24	0.30	0.35
11	40	0.20	0.18	0.15	0.12	0.08	0.04	0.00	0.04	0.08	0.12	0.15	0.18
12	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE XXXVI.

EQUATIONS TO EQUAL ALTITUDES.

First Part.

Interval	Sun's Longitude.												
	X Signs.						XI Signs.						XII S
	0°	5°	10°	15°	20°	25°	0°	5°	10°	15°	20°	25°	0°
	—	—	—	—	—	—	—	—	—	—	—	—	—
h. m.	s	s	s	s	s	s	s	s	s	s	s	s	s
3 0	8.46	9.63	10.70	11.66	12.51	13.26	13.89	14.42	14.84	15.15	15.36	15.47	15.47
3 20	8.51	9.69	10.76	11.73	12.59	13.34	13.98	14.51	14.93	15.25	15.46	15.56	15.57
3 40	8.57	9.75	10.83	11.81	12.68	13.43	14.08	14.61	15.03	15.35	15.57	15.67	15.68
4 0	8.63	9.82	10.91	11.90	12.77	13.53	14.18	14.72	15.14	15.46	15.68	15.78	15.79
4 20	8.70	9.90	11.00	12.00	12.87	13.64	14.29	14.84	15.27	15.59	15.80	15.91	15.93
4 40	8.78	9.99	11.10	12.10	12.99	13.76	14.42	14.97	15.40	15.73	15.95	16.05	16.07
5 0	8.86	10.09	11.21	12.21	13.11	13.89	14.55	15.11	15.55	15.88	16.10	16.21	16.22
5 20	8.95	10.19	11.32	12.34	13.24	14.03	14.70	15.26	15.71	16.04	16.26	16.37	16.38
5 40	9.05	10.30	11.44	12.48	13.39	14.18	14.86	15.43	15.88	16.21	16.44	16.55	16.55
6 0	9.15	10.42	11.58	12.62	13.54	14.35	15.04	15.61	16.06	16.40	16.63	16.74	16.75
6 20	9.27	10.55	11.72	12.77	13.71	14.53	15.23	15.80	16.26	16.60	16.83	16.95	16.95
6 40	9.39	10.69	11.87	12.94	13.89	14.72	15.42	16.01	16.48	16.82	17.05	17.17	17.18
7 0	9.52	10.83	12.04	13.12	14.08	14.92	15.63	16.23	16.71	17.06	17.29	17.41	17.42
7 20	9.66	10.99	12.21	13.31	14.29	15.14	15.86	16.47	16.95	17.31	17.54	17.66	17.67
7 40	9.81	11.16	12.40	13.52	14.51	15.37	16.11	16.72	17.21	17.57	17.81	17.94	17.94
8 0	9.97	11.34	12.60	13.74	14.74	15.62	16.37	16.99	17.49	17.86	18.10	18.23	18.23
8 20	10.14	11.54	12.82	13.97	14.99	15.89	16.65	17.28	17.79	18.16	18.41	18.54	18.54
8 40	10.32	11.74	13.05	14.22	15.26	16.17	16.95	17.59	18.10	18.48	18.74	18.87	18.87
9 0	10.51	11.96	13.29	14.49	15.55	16.47	17.26	17.92	18.44	18.83	19.09	19.22	19.22
9 20	10.72	12.20	13.55	14.77	15.86	16.79	17.60	18.27	18.80	19.20	19.46	19.60	19.61
9 40	10.94	12.44	13.83	15.07	16.18	17.14	17.96	18.65	19.19	19.59	19.86	20.00	20.01
10 0	11.17	12.72	14.12	15.39	16.52	17.51	18.35	19.05	19.60	20.01	20.28	20.43	20.44
10 20	11.42	13.00	14.44	15.74	16.89	17.90	18.76	19.47	20.04	20.45	20.73	20.89	20.91
10 40	11.69	13.30	14.78	16.11	17.29	18.32	19.19	19.92	20.50	20.94	21.22	21.37	21.38
11 0	11.97	13.62	15.14	16.52	17.71	18.76	19.66	20.41	21.00	21.45	21.74	21.89	21.91
11 20	12.28	13.97	15.52	16.92	18.16	19.24	20.16	20.97	21.54	21.99	22.29	22.45	22.46
11 40	12.60	14.34	15.93	17.37	18.64	19.75	20.69	21.48	22.11	22.57	22.88	23.04	23.05
12 0	12.94	14.73	16.37	17.84	19.15	20.29	21.26	22.07	22.72	23.20	23.52	23.68	23.69

Second Part.

	—	—	—	—	—	—	—	—	—	—	—	—	—
h. m.	s	s	s	s	s	s	s	s	s	s	s	s	s
3 0	2.87	3.06	3.16	3.16	3.06	2.87	2.60	2.27	1.88	1.45	0.99	0.50	0.00
3 20	2.83	3.03	3.12	3.12	3.02	2.84	2.57	2.24	1.86	1.43	0.97	0.49	0.00
3 40	2.79	2.99	3.08	3.07	2.98	2.80	2.54	2.21	1.83	1.41	0.96	0.48	0.00
4 0	2.74	2.94	3.03	3.02	2.93	2.75	2.50	2.18	1.80	1.39	0.94	0.47	0.00
4 20	2.70	2.88	2.97	2.97	2.88	2.70	2.45	2.14	1.77	1.36	0.92	0.47	0.00
4 40	2.64	2.82	2.91	2.91	2.82	2.64	2.40	2.10	1.73	1.33	0.90	0.46	0.00
5 0	2.58	2.76	2.85	2.84	2.76	2.58	2.35	2.05	1.69	1.30	0.88	0.45	0.00
5 20	2.52	2.69	2.78	2.77	2.69	2.52	2.29	2.00	1.65	1.27	0.86	0.43	0.00
5 40	2.45	2.62	2.70	2.70	2.62	2.45	2.23	1.94	1.61	1.24	0.84	0.42	0.00
6 0	2.38	2.54	2.62	2.62	2.53	2.38	2.16	1.89	1.56	1.20	0.81	0.41	0.00
6 20	2.30	2.46	2.53	2.53	2.45	2.30	2.09	1.82	1.51	1.16	0.79	0.40	0.00
6 40	2.22	2.37	2.44	2.44	2.36	2.22	2.01	1.76	1.46	1.12	0.76	0.38	0.00
7 0	2.13	2.28	2.34	2.34	2.27	2.13	1.93	1.69	1.40	1.08	0.73	0.37	0.00
7 20	2.04	2.18	2.24	2.24	2.17	2.04	1.85	1.61	1.34	1.03	0.70	0.35	0.00
7 40	1.94	2.07	2.13	2.13	2.06	1.94	1.76	1.53	1.27	0.98	0.66	0.33	0.00
8 0	1.83	1.96	2.02	2.01	1.95	1.83	1.66	1.45	1.20	0.93	0.63	0.32	0.00
8 20	1.72	1.84	1.90	1.89	1.83	1.72	1.56	1.36	1.13	0.87	0.59	0.30	0.00
8 40	1.60	1.71	1.77	1.76	1.71	1.60	1.45	1.27	1.05	0.81	0.55	0.28	0.00
9 0	1.48	1.58	1.63	1.62	1.58	1.48	1.34	1.17	0.97	0.75	0.51	0.26	0.00
9 20	1.35	1.44	1.48	1.48	1.44	1.35	1.22	1.07	0.88	0.68	0.46	0.23	0.00
9 40	1.21	1.29	1.33	1.33	1.29	1.21	1.09	0.96	0.79	0.61	0.41	0.21	0.00
10 0	1.06	1.13	1.17	1.17	1.13	1.06	0.96	0.84	0.70	0.54	0.36	0.18	0.00
10 20	0.91	0.97	1.00	1.00	0.96	0.91	0.82	0.72	0.60	0.46	0.31	0.16	0.00
10 40	0.75	0.80	0.82	0.82	0.79	0.75	0.67	0.59	0.49	0.38	0.25	0.13	0.00
11 0	0.57	0.61	0.63	0.63	0.61	0.57	0.52	0.45	0.37	0.29	0.19	0.10	0.00
11 20	0.39	0.42	0.43	0.43	0.42	0.39	0.36	0.31	0.26	0.20	0.13	0.07	0.00
11 40	0.20	0.22	0.22	0.22	0.21	0.20	0.18	0.16	0.13	0.10	0.07	0.04	0.00
12 0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE XXXVII.

To reduce the EQUATION OF TIME to any given Time from Noon at Greenwich.

When Eq. of time is increasing,	Add after noon. Sub. before noon.	When Eq. of time is decreasing,	Sub. after noon. Add before noon.

Time fr. noon.	Daily Variation.															
	1^{s}	2^{s}	4^{s}	6^{s}	8^{s}	10^{s}	12^{s}	14^{s}	16^{s}	18^{s}	20^{s}	22^{s}	24^{s}	26^{s}	28^{s}	30^{s}
h. m.	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s
0 30	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6
1 0	0.0	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.8	0.9	1.0	1.1	1.2	1.2
1 30	0.1	0.1	0.2	0.4	0.5	0.6	0.8	0.9	1.0	1.1	1.3	1.4	1.5	1.6	1.7	1.8
2 0	0.1	0.2	0.3	0.5	0.7	0.8	1.0	1.2	1.3	1.5	1.7	1.8	2.0	2.2	2.3	2.5
2 30	0.1	0.2	0.4	0.6	0.8	1.0	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.1
3 0	0.1	0.3	0.5	0.7	1.0	1.2	1.5	1.8	2.0	2.2	2.5	2.7	3.0	3.2	3.5	3.7
3 30	0.1	0.3	0.6	0.9	1.2	1.5	1.8	2.0	2.3	2.6	2.9	3.2	3.5	3.7	4.1	4.4
4 0	0.2	0.3	0.7	1.0	1.3	1.7	2.0	2.3	2.6	3.0	3.3	3.7	4.0	4.3	4.7	5.0
4 30	0.2	0.4	0.7	1.1	1.5	1.9	2.3	2.6	3.0	3.4	3.7	4.1	4.5	4.9	5.2	5.6
5 0	0.2	0.4	0.8	1.2	1.7	2.1	2.5	2.9	3.3	3.8	4.2	4.6	5.0	5.4	5.8	6.2
5 30	0.2	0.5	0.9	1.4	1.8	2.3	2.8	3.2	3.7	4.1	4.6	5.0	5.5	5.9	6.4	6.8
6 0	0.2	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5
6 30	0.3	0.5	1.1	1.6	2.2	2.7	3.3	3.8	4.3	4.9	5.4	5.9	6.5	7.0	7.6	8.1
7 0	0.3	0.6	1.2	1.7	2.3	2.9	3.5	4.1	4.7	5.2	5.8	6.4	7.0	7.5	8.1	8.7
7 30	0.3	0.6	1.2	1.9	2.5	3.1	3.8	4.4	5.0	5.6	6.3	6.9	7.5	8.1	8.7	9.4
8 0	0.3	0.7	1.3	2.0	2.7	3.3	4.0	4.7	5.3	6.0	6.7	7.3	8.0	8.6	9.3	10.0
8 30	0.4	0.7	1.4	2.1	2.8	3.5	4.3	5.0	5.7	6.4	7.1	7.8	8.5	9.2	9.9	10.6
9 0	0.4	0.7	1.5	2.2	3.0	3.7	4.5	5.2	6.0	6.8	7.5	8.2	9.0	9.7	10.4	11.2
9 30	0.4	0.8	1.6	2.4	3.2	4.0	4.8	5.5	6.3	7.1	7.9	8.7	9.5	10.2	11.0	11.8
10 0	0.4	0.8	1.7	2.5	3.3	4.2	5.0	5.8	6.7	7.5	8.3	9.2	10.0	10.8	11.6	12.5
10 30	0.4	0.9	1.7	2.6	3.5	4.4	5.3	6.1	7.0	7.9	8.7	9.6	10.5	11.4	12.2	13.1
11 0	0.5	0.9	1.8	2.7	3.7	4.6	5.5	6.4	7.3	8.2	9.2	10.0	11.0	11.9	12.8	13.7
11 30	0.5	1.0	1.9	2.9	3.8	4.8	5.8	6.7	7.7	8.6	9.6	10.5	11.5	12.4	13.4	14.4
12 0	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0

TABLE XXXVIII.

To reduce the SUN'S LONGITUDE to Noon under a given Meridian.

Long.	Sun's Longitude.																									
	O s.		I s.		II s.		III s.		IV s.		V s.		VI s.		VII s.		VIII s		IX s.		X s.		XI s.		XII s.	
°	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″
6	0	59	0	58	0	57	0	57	0	57	0	58	0	59	0	59	1	0	1	1	1	1	1	1	0	59
12	1	59	1	56	1	55	1	54	1	54	1	56	1	55	1	59	2	1	2	2	2	2	2	1	1	59
18	2	58	2	55	2	52	2	51	2	51	2	54	2	57	2	59	3	1	3	3	3	3	3	1	2	58
24	3	58	3	53	3	50	3	48	3	49	3	52	3	56	3	59	4	2	4	5	4	4	4	2	3	58
30	4	57	4	52	4	48	4	46	4	47	4	50	4	54	4	59	5	3	5	6	5	5	5	2	4	57
36	5	57	5	50	5	46	5	43	5	44	5	47	5	53	5	59	6	3	6	7	6	6	6	2	5	57
42	6	56	6	48	6	43	6	40	6	41	6	45	6	52	6	59	7	4	7	8	7	7	7	3	6	56
48	7	56	7	47	7	41	7	37	7	38	7	43	7	51	7	59	8	5	8	9	8	8	8	3	7	56
54	8	55	8	45	8	38	8	34	8	35	8	41	8	50	8	59	9	6	9	11	9	9	9	4	8	55
60	9	55	9	44	9	36	9	32	9	33	9	39	9	48	9	59	10	7	10	12	10	10	10	4	9	55
66	10	54	10	43	10	33	10	29	10	30	10	37	10	47	10	59	11	7	11	13	11	11	11	4	10	54
72	11	54	11	41	11	31	11	26	11	27	11	35	11	46	11	59	12	8	12	14	12	12	12	5	11	54
78	12	53	12	40	12	29	12	23	12	25	12	33	12	45	12	59	13	9	13	15	13	13	13	5	12	53
84	13	53	13	38	13	26	13	20	13	22	13	31	13	44	13	59	14	10	14	17	14	14	14	6	13	53
90	14	52	14	37	14	24	14	18	14	20	14	29	14	43	14	58	15	10	15	18	15	15	15	6	14	52
96	15	52	15	35	15	20	15	15	15	17	15	27	15	42	15	58	16	11	16	19	16	17	16	6	15	52
102	16	51	16	34	16	19	16	12	16	15	16	25	16	41	16	58	17	12	17	20	17	18	17	7	16	51
108	17	51	17	32	17	17	17	9	17	12	17	23	17	40	17	58	18	13	18	21	18	19	18	7	17	51
114	18	50	18	31	18	15	18	6	18	9	18	21	18	39	18	58	19	14	19	23	19	20	19	8	18	50
120	19	49	19	29	19	13	19	4	19	7	19	19	19	37	19	58	20	15	20	24	20	21	20	8	19	49
126	20	49	20	27	20	10	20	1	20	4	20	17	20	36	20	58	21	15	21	25	21	22	21	8	20	49
132	21	48	21	25	21	8	20	58	21	1	21	15	21	35	21	58	22	16	22	26	22	23	22	9	21	48
138	22	48	22	24	22	6	21	55	21	58	22	13	22	34	22	58	23	17	23	27	23	24	23	9	22	48
144	23	47	23	22	23	3	22	53	22	56	23	11	23	33	23	58	24	18	24	29	24	25	24	10	23	47
150	24	47	24	21	24	1	23	50	23	53	24	8	24	32	24	58	25	18	25	30	25	26	25	10	24	47
156	25	46	25	19	24	58	24	47	24	50	25	6	25	31	25	57	26	19	26	31	26	27	26	11	25	46
162	26	46	26	18	25	56	25	45	25	48	26	4	26	30	26	57	27	20	27	32	27	28	27	11	26	46
168	27	45	27	16	26	54	26	42	26	45	27	2	27	29	27	57	28	21	28	33	28	29	28	11	27	45
174	28	45	28	15	27	51	27	39	27	42	28	0	28	28	28	57	29	22	29	35	29	30	29	12	28	45
180	29	44	29	13	28	49	28	37	28	40	28	58	29	26	29	57	30	22	30	36	30	31	30	12	29	44

TABLE XXXIX.

Equations of Second Differences.

Time aft. Noon or Midnight.	Second Difference.												Time aft. Noon or Midnight.
	1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	
h. m.	"	"	"	"	"	"	"	"	"	"	"	"	h. m.
0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	12 0
0 10	0 4	0 8	1 2	1 6	2 1	2 5	2 9	3 3	3 7	4 1	4 5	4 9	11 50
0 20	0 8	1 6	2 4	3 2	4 1	4 9	5 7	6 5	7 3	8 1	8 9	9 7	11 40
0 30	1 2	2 4	3 6	4 8	6 0	7 2	8 4	9 6	10 8	12 0	13 2	14 4	11 30
0 40	1 6	3 1	4 7	6 3	7 9	9 4	11 0	12 6	14 2	15 7	17 3	18 9	11 20
0 50	1 9	3 9	5 8	7 8	9 7	11 6	13 5	15 5	17 4	19 4	21 3	23 3	11 10
1 0	2 3	4 6	6 9	0 2	11 5	13 8	16 0	18 3	20 6	22 9	25 2	27 5	11 0
1 10	2 6	5 3	7 9	10 5	13 2	15 8	18 4	21 1	23 7	26 3	29 0	31 6	10 50
1 20	3 0	5 9	8 9	11 9	14 8	17 8	20 7	23 7	26 7	29 6	32 6	35 6	10 40
1 30	3 3	6 6	9 8	13 1	16 4	19 7	23 0	26 3	29 5	32 8	36 1	39 4	10 30
1 40	3 6	7 2	10 8	14 4	17 9	21 5	25 1	28 7	32 3	35 9	39 5	43 1	10 20
1 50	3 9	7 8	11 6	15 5	19 4	23 3	27 2	31 1	34 9	38 8	42 7	46 6	10 10
2 0	4 2	8 3	12 5	16 7	20 8	25 0	29 2	33 3	37 5	41 7	45 8	50 0	10 0
2 10	4 4	8 9	13 3	17 8	22 2	26 6	31 1	35 5	39 9	44 4	48 8	53 3	9 50
2 20	4 7	9 4	14 1	18 8	23 5	28 2	32 9	37 6	42 3	47 0	51 7	56 4	9 40
2 30	4 9	9 9	14 8	19 8	24 7	29 7	34 6	39 6	44 5	49 5	54 4	59 4	9 30
2 40	5 2	10 4	15 6	20 7	25 9	31 1	36 3	41 5	46 7	51 9	57 0	62 2	9 20
2 50	5 4	10 8	16 2	21 6	27 1	32 5	37 9	43 3	48 7	54 1	59 5	64 9	9 10
3 0	5 6	11 3	16 9	22 5	28 1	33 8	39 4	45 0	50 6	56 2	61 9	67 5	9 0
3 10	5 8	11 7	17 5	23 3	29 1	35 0	40 8	46 6	52 4	58 3	64 1	69 9	8 50
3 20	6 0	12 0	18 1	24 1	30 1	36 1	42 1	48 1	54 2	60 2	66 2	72 2	8 40
3 30	6 2	12 4	18 6	24 8	31 0	37 2	43 4	49 6	55 8	62 0	68 2	74 4	8 30
3 40	6 4	12 7	19 1	25 5	31 8	38 2	44 6	50 9	57 3	63 7	70 0	76 4	8 20
3 50	6 5	13 0	19 6	26 1	32 6	39 1	45 7	52 2	58 7	65 2	71 7	78 3	8 10
4 0	6 7	13 3	20 0	26 7	33 3	40 0	46 7	53 3	60 0	66 7	73 3	80 0	8 0
4 20	6 9	13 8	20 8	27 7	34 6	41 5	48 4	55 4	62 3	69 2	76 1	83 1	7 40
4 40	7 1	14 3	21 4	28 5	35 6	42 8	49 9	57 0	64 2	71 3	78 4	85 6	7 20
5 0	7 3	14 6	21 9	29 2	36 5	43 8	51 0	58 3	65 6	72 9	80 2	87 5	7 0
5 20	7 4	14 8	22 2	29 6	37 0	44 4	51 9	59 3	66 7	74 1	81 5	88 9	6 40
5 40	7 5	15 0	22 4	29 9	37 4	44 9	52 3	59 8	67 3	74 8	82 2	89 7	6 20
6 0	7 5	15 0	22 5	30 0	37 5	45 0	52 5	60 0	67 5	75 0	82 5	90 0	6 0

Time aft. N. or Midn.	Second Difference.																Time aft. N. or Midn
	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	15"	20"	25"	30"	40"	50"	
h. m.	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	h. m.
0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	12 0
0 10	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 1	0 1	0 1	0 1	0 2	0 2	0 3	0 3	11 50
0 20	0 0	0 0	0 0	0 0	0 1	0 1	0 1	0 1	0 1	0 1	0 2	0 3	0 3	0 4	0 5	0 7	11 40
0 30	0 0	0 0	0 1	0 1	0 1	0 1	0 1	0 2	0 2	0 2	0 3	0 4	0 5	0 6	0 8	1 0	11 30
0 40	0 0	0 1	0 1	0 1	0 1	0 2	0 2	0 2	0 2	0 3	0 4	0 5	0 7	0 8	1 0	1 3	11 20
0 50	0 0	0 1	0 1	0 1	0 2	0 2	0 2	0 3	0 3	0 3	0 5	0 6	0 8	1 0	1 3	1 6	11 10
1 0	0 0	0 1	0 1	0 1	0 2	0 2	0 3	0 3	0 3	0 4	0 6	0 8	0 9	1 1	1 5	1 9	11 0
1 10	0 0	0 1	0 1	0 2	0 2	0 3	0 3	0 3	0 4	0 4	0 7	0 9	1 1	1 3	1 8	2 2	10 50
1 20	0 0	0 1	0 1	0 2	0 2	0 3	0 3	0 4	0 4	0 5	0 7	1 0	1 2	1 5	2 0	2 5	10 40
1 30	0 0	0 1	0 2	0 2	0 3	0 3	0 4	0 4	0 5	0 5	0 8	1 1	1 4	1 6	2 2	2 7	10 30
1 40	0 1	0 1	0 2	0 2	0 3	0 4	0 4	0 5	0 5	0 6	0 9	1 2	1 5	1 8	2 4	3 0	10 20
1 50	0 1	0 1	0 2	0 3	0 3	0 4	0 4	0 5	0 6	0 6	1 0	1 3	1 6	1 9	2 6	3 2	10 10
2 0	0 1	0 1	0 2	0 3	0 3	0 4	0 5	0 6	0 6	0 7	1 0	1 4	1 7	2 1	2 8	3 5	10 0
2 10	0 1	0 1	0 2	0 3	0 4	0 4	0 5	0 6	0 7	0 7	1 1	1 5	1 8	2 2	3 0	3 7	9 50
2 20	0 1	0 2	0 2	0 3	0 4	0 5	0 5	0 6	0 7	0 8	1 2	1 6	2 0	2 3	3 1	3 9	9 40
2 30	0 1	0 2	0 2	0 3	0 4	0 5	0 6	0 7	0 7	0 8	1 2	1 6	2 1	2 5	3 3	4 1	9 30
2 40	0 1	0 2	0 3	0 3	0 4	0 5	0 6	0 7	0 8	0 9	1 3	1 7	2 2	2 6	3 5	4 3	9 20
2 50	0 1	0 2	0 3	0 4	0 4	0 5	0 6	0 7	0 8	0 9	1 3	1 8	2 2	2 7	3 6	4 5	9 10
3 0	0 1	0 2	0 3	0 4	0 5	0 6	0 7	0 7	0 8	0 9	1 4	1 9	2 3	2 8	3 8	4 7	9 0
3 10	0 1	0 2	0 3	0 4	0 5	0 6	0 7	0 8	0 9	1 0	1 5	1 9	2 4	2 9	3 9	4 9	8 50
3 20	0 1	0 2	0 3	0 4	0 5	0 6	0 7	0 8	0 9	1 0	1 5	2 0	2 5	3 0	4 0	5 0	8 40
3 30	0 1	0 2	0 3	0 4	0 5	0 6	0 7	0 8	0 9	1 0	1 5	2 1	2 6	3 1	4 1	5 2	8 30
3 40	0 1	0 2	0 3	0 4	0 5	0 6	0 7	0 8	0.9	1 1	1 6	2 1	2 6	3 2	4 2	5 3	8 20
3 50	0 1	0 2	0 3	0 4	0 5	0 6	0 8	0 9	1 0	1 1	1 6	2 2	2 7	3 3	4 3	5 4	8 10
4 0	0 1	0 2	0 3	0 4	0 6	0 7	0 8	0 9	1 0	1 1	1 7	2 2	2 8	3 3	4 4	5 6	8 0
4 20	0 1	0 2	0 3	0 5	0 6	0 7	0 8	0 9	1 0	1 2	1 7	2 3	2 9	3 5	4 6	5 8	7 40
4 40	0 1	0 2	0 4	0 5	0 6	0 7	0 8	0 9	1 0	1 2	1 8	2 4	3 0	3 6	4 8	5 9	7 20
5 0	0 1	0 2	0 4	0 5	0 6	0 7	0 8	1 0	1 1	1 2	1 8	2 4	3 0	3 6	4 9	6 1	7 0
6 0	0 1	0 2	0 4	0 5	0 6	0 7	0 9	1 0	1 1	1 3	1 9	2 5	3 1	3 8	5 0	6 3	6 0

TABLE XL.

For finding the Time from Noon when the SUN bears true East or West.

Lat.	Declination of the same Name with the Latitude.															
	0°	2°	4°	6°	8°	10°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°
°	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0
1	6 0	4 0	5 2	5 22	5 31	5 37	5 41	5 44	5 46	5 48	5 49	5 50	5 51	5 52	5 52	5 53
2	6 0	0 0	4 0	4 42	5 2	5 14	5 22	5 28	5 32	5 35	5 38	5 40	5 42	5 44	5 45	5 46
3	6 0	3 13	2 46	4 0	4 32	4 51	5 3	5 11	5 18	5 23	5 27	5 30	5 33	5 35	5 37	5 39
4	6 0	4 0	0 0	3 13	4 1	4 27	4 43	4 55	5 4	5 10	5 16	5 20	5 24	5 27	5 30	5 32
5	6 0	4 26	2 28	2 15	3 26	4 1	4 23	4 38	4 49	4 58	5 4	5 10	5 15	5 19	5 22	5 25
6	6 0	4 42	3 13	0 0	2 46	3 34	4 1	4 20	4 34	4 45	4 53	5 0	5 5	5 10	5 14	5 18
7	6 0	4 54	3 41	2 5	1 56	3 3	3 39	4 2	4 19	4 31	4 41	4 49	4 56	5 2	5 7	5 11
8	6 0	5 2	4 1	2 46	0 0	2 29	3 14	3 43	4 3	4 17	4 29	4 39	4 46	4 53	4 59	5 4
9	6 0	5 9	4 15	3 14	1 50	1 44	2 47	3 22	3 46	4 3	4 17	4 28	4 37	4 44	4 51	4 56
10	6 0	5 14	4 27	3 34	2 29	0 0	2 16	3 0	3 28	3 49	4 4	4 16	4 27	4 35	4 43	4 49
11	6 0	5 19	4 36	3 49	2 55	1 40	1 35	2 35	3 9	3 33	3 51	4 5	4 16	4 26	4 34	4 41
12	6 0	5 22	4 43	4 1	3 14	2 16	0 0	2 6	2 49	3 17	3 37	3 53	4 6	4 17	4 25	4 34
13	6 0	5 25	4 49	4 12	3 30	2 41	1 32	1 29	2 26	2 59	3 23	3 41	3 55	4 7	4 17	4 26
14	6 0	5 28	4 55	4 20	3 43	3 0	2 6	0 0	1 58	2 40	3 7	3 28	3 44	3 57	4 8	4 18
15	6 0	5 30	4 59	4 28	3 53	3 15	2 30	1 26	1 23	2 18	2 50	3 14	3 32	3 47	3 59	4 9
16	6 0	5 32	5 4	4 34	4 3	3 28	2 49	1 58	0 0	1 52	2 32	2 59	3 20	3 36	3 49	4 1
17	6 0	5 34	5 7	4 40	4 11	3 39	3 4	2 21	1 21	1 19	2 11	2 43	3 7	3 25	3 40	3 52
18	6 0	5 35	5 10	4 45	4 17	3 49	3 17	2 40	1 52	0 0	1 47	2 26	2 53	3 13	3 29	3 43
19	6 0	5 37	5 13	4 49	4 24	3 57	3 28	2 54	2 14	1 17	1 16	2 6	2 37	3 1	3 19	3 34
20	6 0	5 38	5 16	4 53	4 29	4 4	3 37	3 7	2 32	1 47	0 0	1 43	2 21	2 47	3 7	3 24
21	6 0	5 39	5 18	4 56	4 34	4 11	3 46	3 18	2 47	2 9	1 14	1 13	2 2	2 32	2 55	3 13
22	6 0	5 40	5 20	5 0	4 39	4 16	3 53	3 28	2 59	2 26	1 43	0 0	1 39	2 16	2 42	3 2
23	6 0	5 41	5 22	5 3	4 43	4 22	4 0	3 36	3 10	2 40	2 4	1 11	1 10	1 58	2 28	2 51
24	6 0	5 42	5 24	5 5	4 46	4 27	4 6	3 44	3 20	2 53	2 21	1 39	0 0	1 36	2 13	2 38
25	6 0	5 43	5 26	5 8	4 50	4 31	4 12	3 51	3 28	3 3	2 35	2 0	1 9	1 8	1 55	2 25
26	6 0	5 44	5 27	5 10	4 53	4 35	4 17	3 57	3 36	3 13	2 47	2 16	1 36	0 0	1 34	2 9
27	6 0	5 44	5 28	5 12	4 56	4 39	4 21	4 3	3 43	3 22	2 58	2 30	1 56	1 7	1 6	1 51
28	6 0	5 45	5 30	5 14	4 59	4 43	4 26	4 8	3 49	3 29	3 7	2 42	2 13	1 34	0 0	1 32
29	6 0	5 46	5 31	5 16	5 1	4 46	4 30	4 13	3 55	3 36	3 16	2 53	2 26	1 54	1 6	1 5
30	6 0	5 46	5 32	5 18	5 4	4 49	4 34	4 18	4 1	3 43	3 24	3 2	2 38	2 9	1 32	0 0
31	6 0	5 47	5 33	5 20	5 6	4 52	4 37	4 22	4 6	3 49	3 31	3 11	2 49	2 23	1 51	1 4
32	6 0	5 47	5 34	5 21	5 8	4 54	4 40	4 26	4 11	3 55	3 38	3 19	2 58	2 35	2 7	1 30
33	6 0	5 48	5 35	5 23	5 10	4 57	4 44	4 30	4 15	4 0	3 44	3 26	3 7	2 45	2 20	1 49
34	6 0	5 48	5 36	5 24	5 12	4 59	4 47	4 33	4 19	4 5	3 49	3 33	3 15	2 55	2 32	2 5
35	6 0	5 49	5 37	5 25	5 14	5 2	4 49	4 37	4 23	4 9	3 55	3 39	3 22	3 3	2 43	2 18
36	6 0	5 49	5 38	5 27	5 15	5 4	4 52	4 40	4 27	4 14	4 0	3 45	3 29	3 11	2 52	2 30
37	6 0	5 49	5 39	5 28	5 17	5 6	4 54	4 43	4 31	4 18	4 4	3 50	3 35	3 19	3 0	2 40
38	6 0	5 50	5 39	5 29	5 19	5 8	4 57	4 46	4 34	4 22	4 9	3 55	3 41	3 25	3 8	2 49
39	6 0	5 50	5 40	5 30	5 20	5 10	4 59	4 48	4 37	4 25	4 13	4 0	3 47	3 32	3 16	2 58
40	6 0	5 50	5 41	5 31	5 21	5 11	5 1	4 51	4 40	4 29	4 17	4 5	3 52	3 38	3 23	3 6
42	6 0	5 51	5 42	5 33	5 24	5 15	5 5	4 56	4 46	4 35	4 25	4 13	4 1	3 49	3 35	3 20
44	6 0	5 52	5 43	5 35	5 27	5 18	5 9	5 0	4 51	4 41	4 31	4 21	4 10	3 59	3 46	3 33
46	6 0	5 52	5 45	5 37	5 29	5 21	5 13	5 4	4 56	4 47	4 38	4 28	4 18	4 8	3 57	3 44
48	6 0	5 53	5 46	5 38	5 31	5 23	5 16	5 8	5 0	4 52	4 43	4 35	4 25	4 16	4 6	3 55
50	6 0	5 53	5 47	5 40	5 33	5 26	5 19	5 12	5 4	4 57	4 49	4 41	4 32	4 23	4 14	4 4
52	6 0	5 54	5 47	5 41	5 35	5 28	5 22	5 15	5 8	5 1	4 54	4 46	4 39	4 30	4 22	4 13
54	6 0	5 54	5 48	5 42	5 37	5 31	5 24	5 18	5 12	5 5	4 59	4 52	4 45	4 37	4 29	4 21
56	6 0	5 55	5 49	5 44	5 38	5 33	5 27	5 21	5 15	5 9	5 3	4 57	4 50	4 43	4 36	4 28
58	6 0	5 55	5 50	5 45	5 40	5 35	5 29	5 24	5 19	5 13	5 7	5 2	4 55	4 49	4 42	4 35
60	6 0	5 55	5 51	5 46	5 41	5 37	5 32	5 27	5 22	5 17	5 11	5 6	5 0	4 55	4 48	4 42
62	6 0	5 56	5 51	5 47	5 43	5 38	5 34	5 30	5 25	5 20	5 15	5 10	5 5	5 0	4 54	4 48
64	6 0	5 56	5 52	5 48	5 44	5 40	5 36	5 32	5 28	5 24	5 19	5 15	5 10	5 5	5 0	4 55
66	6 0	5 56	5 53	5 49	5 46	5 42	5 38	5 35	5 31	5 27	5 23	5 19	5 14	5 10	5 5	5 0
68	6 0	5 57	5 54	5 50	5 47	5 44	5 40	5 37	5 33	5 30	5 26	5 22	5 19	5 15	5 10	5 6
70	6 0	5 57	5 54	5 51	5 48	5 45	5 42	5 39	5 36	5 33	5 30	5 26	5 23	5 19	5 15	5 12
72	6 0	5 57	5 55	5 52	5 50	5 47	5 44	5 41	5 39	5 36	5 33	5 30	5 27	5 24	5 20	5 17
74	6 0	5 58	5 55	5 53	5 51	5 48	5 46	5 44	5 41	5 39	5 36	5 33	5 31	5 28	5 25	5 22
76	6 0	5 58	5 56	5 54	5 52	5 50	5 48	5 46	5 44	5 41	5 39	5 37	5 35	5 32	5 30	5 27
78	6 0	5 58	5 57	5 55	5 53	5 51	5 50	5 48	5 46	5 44	5 42	5 40	5 38	5 36	5 34	5 32
80	6 0	5 58	5 57	5 56	5 54	5 53	5 51	5 50	5 48	5 47	5 45	5 44	5 42	5 40	5 38	5 37

TABLE XLI.

To reduce the Moon's Horizontal Parallax and Semidiameter to any Time under the Meridian of Greenwich.

Diff. in 12 hrs.	Reduced Time after Noon or Midnight.																Diff. in 12 hrs.
	h.m. 0 10	h.m. 0 20	h.m. 0 30	h.m. 0 40	h.m. 0 50	h.m. 1 0	h.m. 2 0	h.m. 3 0	h.m. 4 0	h.m. 5 0	h.m. 6 0	h.m. 7 0	h.m. 8 0	h.m. 9 0	h.m. 10 0	h.m. 11 0	
1″	0″	0″	0″	0″	0″	0″	0″	0″	0″	0″	0″	1″	1″	1″	1″	1″	1″
2	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2	2
3	0	0	0	0	0	0	0	1	1	1	1	2	2	2	3	3	3
4	0	0	0	0	0	0	1	1	1	2	2	2	3	3	3	4	4
5	0	0	0	0	0	0	1	1	2	2	2	3	3	4	4	5	5
6	0	0	0	0	0	0	1	1	2	2	3	3	4	5	5	6	6
7	0	0	0	0	0	1	1	2	2	3	3	4	5	5	6	6	7
8	0	0	0	0	1	1	1	2	3	3	4	5	5	6	7	7	8
9	0	0	0	0	1	1	1	2	3	4	4	5	6	7	8	8	9
10	0	0	0	1	1	1	2	2	3	4	5	6	7	8	8	9	10
11	0	0	0	1	1	1	2	3	4	5	5	6	7	8	9	10	11
12	0	0	0	1	1	1	2	3	4	5	6	7	8	9	10	11	12
13	0	0	1	1	1	1	2	3	4	5	6	8	9	10	11	12	13
14	0	0	1	1	1	1	2	3	5	6	7	8	9	11	12	13	14
15	0	0	1	1	1	1	2	4	5	6	7	9	10	11	13	14	15
16	0	0	1	1	1	1	3	4	5	7	8	9	11	12	13	15	16
17	0	0	1	1	1	1	3	4	6	7	8	10	11	13	14	16	17
18	0	0	1	1	1	1	3	4	6	7	9	11	12	14	15	17	18
19	0	1	1	1	1	2	3	5	6	8	9	11	13	14	16	17	19
20	0	1	1	1	1	2	3	5	7	8	10	12	13	15	17	18	20
21	0	1	1	1	2	2	3	5	7	9	10	12	14	16	18	19	21
22	0	1	1	1	2	2	4	5	7	9	11	13	15	17	18	20	22
23	0	1	1	1	2	2	4	6	8	10	11	13	15	17	19	21	23
24	0	1	1	1	2	2	4	6	8	10	12	14	16	18	20	22	24
25	0	1	1	1	2	2	4	6	8	10	12	15	17	19	21	23	25
26	0	1	1	1	2	2	4	6	9	11	13	15	17	20	22	24	26
27	0	1	1	1	2	2	4	7	9	11	13	16	18	20	23	25	27
28	0	1	1	2	2	2	5	7	9	12	14	16	19	21	23	26	28
29	0	1	1	2	2	2	5	7	10	12	14	17	19	22	24	27	29
30	0	1	1	2	2	2	5	7	10	12	15	17	20	23	25	28	30
31	0	1	1	2	2	3	5	8	10	13	15	18	21	23	26	28	31
32	0	1	1	2	2	3	5	8	11	13	16	19	21	24	27	29	32
33	0	1	1	2	2	3	5	8	11	14	16	19	22	25	28	30	33
34	0	1	1	2	2	3	6	8	11	14	17	20	22	26	28	31	34
35	0	1	1	2	2	3	6	9	12	15	17	20	23	26	29	32	35
36	0	1	2	2	2	3	6	9	12	15	18	21	24	27	30	33	36
37	1	1	2	2	3	3	6	9	12	15	18	22	25	28	31	34	37
38	1	1	2	2	3	3	6	9	13	16	19	22	25	29	32	35	38
39	1	1	2	2	3	3	6	10	13	16	19	23	26	29	33	36	39
40	1	1	2	2	3	3	7	10	13	17	20	23	27	30	33	37	40
41	1	1	2	2	3	3	7	10	14	17	20	24	27	31	34	38	41
42	1	1	2	2	3	3	7	10	14	17	21	25	28	32	35	39	42
43	1	1	2	2	3	4	7	11	14	18	21	25	29	32	36	40	43
44	1	1	2	2	3	4	7	11	15	18	22	26	29	33	37	40	44
45	1	1	2	2	3	4	7	11	15	19	22	26	30	34	38	41	45
46	1	1	2	3	3	4	8	11	15	19	23	27	31	35	38	42	46
47	1	1	2	3	3	4	8	12	16	19	23	27	31	35	39	43	47
48	1	1	2	3	3	4	8	12	16	20	24	28	32	36	40	44	48
49	1	1	2	3	3	4	8	12	16	20	24	29	33	37	41	45	49
50	1	1	2	3	4	4	8	12	17	21	25	29	33	38	42	46	50
51	1	1	2	3	4	4	8	13	17	21	25	30	34	38	43	47	51
52	1	1	2	3	4	4	9	13	17	22	26	30	35	39	43	48	52
53	1	1	2	3	4	4	9	13	18	22	26	31	35	40	44	49	53
54	1	2	2	3	4	4	9	13	18	22	27	32	36	41	45	50	54
55	1	2	2	3	4	5	9	14	18	23	27	32	37	42	46	50	55
56	1	2	2	3	4	5	9	14	19	23	28	33	37	42	47	51	56
57	1	2	2	3	4	5	9	14	19	24	28	33	38	43	48	52	57
58	1	2	2	3	4	5	10	14	19	24	29	34	39	44	48	53	58
59	1	2	2	3	4	5	10	15	20	25	29	34	39	44	49	54	59
60	1	2	2	3	4	5	10	15	20	25	30	35	40	45	50	55	60

TABLE XLII.

LATITUDES AND LONGITUDES

Of the principal Ports, Harbours, Capes, Shoals, Rocks, &c. in the World, founded on several thousand Observations made by the most eminent Astronomers and Navigators, compared with the latest and most accurate Charts and Surveys; to which is occasionally added the Variation of the Compass.

The Longitudes are reckoned from the Meridian of Greenwich.

I. Coast of GREAT BRITAIN, and adjacent Islands.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	LONDON, St. P.	51	30	49 N	0	5	47 W
	Greenwich, obs.	51	28	40	0	0	0
	Sheerness Flag Staff	51	26	45	0	44	26 E
South Coast of England.	*Var. 24° 30′ W.*						
	N. Foreland, Light	51	22	25	1	26	34
	Deal Castle	51	13	5	1	23	59
	S. Foreland	51	8	26	1	22	6
	Dover Castle	51	7	47	1	19	7
	Dungeness Light .	50	55	1	0	57	48
	Hastings	50	52	10	0	38	0
	Beachy Head....	50	44	24	0	15	12
	Brighton	50	49	32	0	7	40 W
	Shoreham	50	50	0	0	16	19
	Arundel	50	51	0	0	36	0
	Owers, Light......	50	39	57	0	39	59
	Selsea Bill	50	43	30	0	47	54
	Portsmouth Ch..	50	47	27	1	5	57
I. of Wight.	**Cowes ....**	50	45	37	1	16	15
	Bembridge Point .	50	40	59	1	5	26
	Dunnose	50	37	7	1	11	36
	St. Catherine's Pt.	50	35	33	1	17	51
	Needles Lights ...	50	39	53	1	33	55
	Hurst Lights	50	42	23	1	32	50
	Poole............	50	42	50	1	58	55
	St. Aldan's Head..	50	32	30	2	5	0
	Weymouth......	50	36	0	2	27	0
	Portland Lights ..	50	31	22	2	26	49
	Exmouth Bar.....	50	36	40	3	21	30
	Torbay, Berry hd.	50	24	1	3	28	14
	Dartmouth	50	19	40	3	35	30
South Coast of England.	**Start Point.......**	50	13	26	3	38	20
	Praule Point	50	13	15	3	42	30
	Bolt Head	50	13	45	3	48	3
	Eddystone Light..	50	10	54	4	15	3
	Hand Deeps	50	13	0	4	19	0
	Ram Head	50	18	52	4	12	29
	Plymouth Dock.	50	22	19	4	9	58
	Drake's Island....	50	21	28	4	8	18
	Fowey............	50	20	7	4	37	31
	Deadman's Point .	50	13	20	4	47	4
	Falmouth,						
	—Pendennis Castle	50	8	49	5	1	44
	Manacles Rocks ..	50	2	0	5	1	0
	Black Head	50	1	12	5	3	59
	Lizard Point	49	57	56	5	11	18
	Mount's Bay,						
	—Penzance	50	7	30	5	30	30
	Runnelstone, Beac.	50	1	30	5	39	0
	Wolf Rock.......	49	55	45	5	48	0
	Land's End	50	4	7 N	5	41	31 W
	Var. 26° 30′ W.						
	Scilly Islands,						
	—St. Agnes Light.	49	53	37	6	19	23
	—St. Mary's	49	54	33	6	16	59
	The Seven Stones.	50	2	30	6	6	0
	Cape Cornwall....	50	8	0	5	41	0
	St. Ives..........	50	13	0	5	28	0
	St. Agnes, Beacon	50	18	27	5	11	56
	Trevose Head	50	32	57	5	0	54
	Padstow	50	35	0	4	55	0
	Tintagel Head....	50	40	0	4	45	0
	Hartland Point ...	51	1	22	4	30	26
	Mort Point.......	51	11	0	4	13	0
	Lundy Isle	51	9	57	4	38	28
	Flatholm Light ...	51	23	0	3	6	0
	Bristol.........	51	27	6	2	35	29
	Nash Point.......	51	24	30	3	33	0
West Coast of England.	**Mumbles Pt. & Lt.**	51	34	0	3	57	0
	Worms Head	51	33	56	4	18	56
	Caldy Island	51	37	0	4	40	0
	St. Gowan's Point.	51	36	0	4	56	0
	St. Ann's Lights ..	51	40	59	5	9	19
	Smalls Light	51	43	18	5	38	54
	St. David's Head .	51	54	30	5	17	30
	Strumble Head ...	52	1	0	5	6	0
	Dinas Point	52	2	0	4	53	0
	Cardigan Harbour	52	7	0	4	42	0
	Aberistwith	52	25	0	3	58	0
	Barmouth	52	41	0	3	55	0
	Bardsey Island ...	52	44	0	4	39	0
	Brachy Pool Head	52	46	0	4	37	0
	Holyhead I. W. end	53	18	0	4	36	0
	Skerries Light	53	24	0	4	33	0
	Var. 2½ Points W.						
	Point Linas, Light	53	24	0	4	12	0
	Great Ormes Head	53	20	0	3	50	0
	Point of Air, Light	53	21	30	3	18	30
	Liverpool	53	24	40	2	58	45
	Formby Point	53	32	30	3	5	0
	Lancaster	54	3	0	2	47	0
	Selker Rock......	54	17	0	3	27	0
	St. Bees Hd. Light	54	31	0	3	37	30
	Whitehaven	54	33	0	3	35	0
	Carlisle........	54	56	0	2	54	0
I. of Man.	**Air Point ....**	54	26	0	4	23	0
	Douglass.........	54	9	0	4	29	0
	Castletown	54	4	0	4	40	0
	Calf	54	2	0	4	49	0
	Ross Head.......	54	47	0	4	6	0
	Burrow Head	54	41	0	4	24	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
West and North Coast of Scotland.	Scars	54	39	0 N	4	42	0 W
	Mull of Galloway	54	38	0	4	50	0
	Port Patrick, Light	54	48	0	5	3	0
	Loch Ryan	55	6	0	4	57	0
	Air, Light	55	25	0	4	26	0
	Irwin	55	37	0	5	9	0
	Elsa Island	55	14	58	5	6	0
	Cumray Isle, Light	55	43	0	4	57	0
	Greenock	55	57	0	4	44	30
	GLASGOW	55	51	32	4	15	0
	Pladda Light	55	30	0	5	4	0
	MULL of Cantire	55	17	0	5	41	0
	Var. 30° *W.*						
	Tonvore Head	55	54	0	6	22	0
	Runs Point	55	47	0	6	21	0
	Skerryvore Rocks	56	16	0	7	2	0
	Dusker Rock	56	34	0	6	57	0
	Coll Island, N. end	56	42	0	6	20	0
	Rum Island, S. end	56	55	0	6	11	0
	Helsker Island	56	56	0	6	36	0
	Dunvegan Head	57	30	0	6	40	0
	Rea Head	57	50	0	5	39	0
	More Head	58	5	0	5	16	0
	Stower Head	58	14	0	5	14	0
	Cape Wrath	58	36	40	4	56	0
	Rona Island	58	55	0	5	52	0
	Barra Island	58	54	0	6	3	0
	Farout Head	58	37	0	4	45	0
	Dunnet Head	58	42	0	3	29	0
	Duncansby Head	58	40	0	3	8	0
	Var. 30° *W.*						
Lewis Islands.	Mingalay Island	56	48	0	7	33	0
	South Ulst, S. end	57	5	0	7	10	0
	Renish Head	57	41	0	6	53	0
	Glash Island, Light	57	50	0	6	33	0
	Aird Point	58	15	0	6	1	0
	Butt of Lewis	58	29	0	6	12	0
	Gallen Head	58	10	0	7	1	0
	Flannen Isles	58	14	0	7	30	0
	Sr. Kilda	57	49	0	8	26	0
	Hyskar Island	57	38	0	7	38	0
	Rockal	57	39	30	13	31	0
Orkney Islands.	Pentland Skerries	58	43	0	3	3	0
	Stroma Isle, S. end	58	43	0	3	14	0
	S. Ronaldsha, S. Pt.	58	45	0	3	5	0
	Copînsha	58	56	0	2	48	0
	Stronsa I. S. Pt.	59	5	0	2	40	0
	N. Ronaldsha, N. Pt	59	23	0	2	34	0
	Papa Westra Isle, —Mould Head	59	22	0	3	3	0
	Westra Island, —Noup Head	59	19	0	3	13	0
	Pomona Island, —Marwick Head	59	7	0	3	27	0
	—Stromness	58	57	0	3	25	0
	Slue Skerries	59	3	0	4	14	0
	Fair Island	59	29	0	1	45	0
	Sunbro' Head	59	51	40	1	15	0
	Hangcliff	60	9	0	0	56	30

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
Shetland Islands.	LERWICK	60	9	0 N	1	6	0 W
	Rumble Island	60	21	0	0	53	0
	Out Skerries	60	29	30	0	46	0
	Lambaness	60	48	0	0	58	30
	Var. 27° 40′ *W.*						
	Ronas Hill	60	33	0	1	34	0
	Ossa Skerries	60	28	0	1	44	0
	Ve Skerries	60	21	0	1	52	0
	Foul Island	60	5	0	2	4	0
Faro Isl.	Monk Rock	61	23	0	6	52	0
	Fucloe Island	62	21	0	6	18	0
	Mygines Island	62	8	0	7	42	0
East Coast of Scotland.	Noss Head	58	30	0	3	9	0
	Clyth Ness	58	20	0	3	16	0
	Ord Head	58	10	0	3	35	0
	Tarbett Ness	57	54	0	3	47	0
	Cromartie	57	42	0	4	1	0
	INVERNESS	57	31	0	4	12	0
	Fort St. George	57	37	0	4	5	0
	Burgh Head	57	43	0	3	30	0
	Cousy Point	57	44	0	3	17	0
	Cullen	57	42	0	2	50	0
	Bamff	57	40	0	2	32	0
	Kinnaird's Head	57	42	0	2	1	0
	Ratrie Head	57	38	0	1	50	0
	Peter Head	57	32	0	1	47	0
	Buchan Ness	57	30	0	1	47	0
	Var. 28° *W.*						
	Newburgh	57	20	0	2	3	0
	N. ABERDEEN, obs.	57	9	0	2	9	0
	Girdleness	57	8	0	2	6	0
	Stonehaven	56	58	0	2	13	0
	Tod Head	56	53	0	2	15	0
	Montrose Ness	56	42	0	2	26	0
	Red Head	56	38	0	2	28	0
	Arbroath	56	34	0	2	35	0
	Button Ness & Lts.	56	28	0	2	45	0
	DUNDEE	56	28	0	2	58	0
	Inch Cape Light, or Bell Rock	56	26	0	2	23	0
	St. Andrew's	56	21	0	2	47	0
	Fife Ness	56	17	0	2	35	0
	Elly Ness	56	12	0	2	50	0
	EDINBURGH	55	56	42	3	12	15
	Inch Keith	56	3	0	3	10	0
	Fidra	56	5	30	2	46	0
	North Berwick	56	4	0	2	42	0
	May I. and Light	56	11	22	2	32	47
	The Bass	56	4	53	2	37	47
	DUNBAR	56	0	0	2	30	0
	St. Abb's Head	55	55	0	2	8	0
	Eyemouth	55	53	0	2	6	0
	Var. 2½ *Points W.*						
	BERWICK	55	46	21	1	59	41
	Holy Island	55	40	20	1	46	38
	Bamburgh Castle	55	36	42	1	42	8
	Staples Light	55	38	9	1	37	5
	Fern I. Light	55	37	11	1	38	51
	Sunderland Point	55	34	45	1	37	56

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
East Coast of England.	Coquet Island	55	20	11 N	1	31	47 W
	Tinmouth, Light..	55	1	21	1	24	31
	Hartlepool	54	41	49	1	10	31
	River Tees, entr...	54	38	0	1	5	0
	Stockton.........	54	33	0	1	20	0
	WHITBY.........	54	28	30	0	36	30
	Scarborough	54	18	0	0	24	0
	Filey Brig........	54	14	0	0	15	0
	Flamborough Head	54	8	0	0	2	30
	Spurn Lights	53	37	13	0	12	12 E
	Lynn Regis	52	46	52	0	25	4
	Outer Dowsing ...	53	30	0	0	55	0
	Haddock's Bank..	53	33	0	1	24	0
	Dudgeon Light ...	53	18	0	0	55	0
	Inner Dowsing ...	53	18	0	0	34	0
	Cromer Inner Bank	53	9	0	1	24	0
	Lemon, mid.	53	10	0	1	54	0
	Var. 2¼ Points W.						
	Sherringham Shs. .	53	2	0	1	10	0
	Smith's Knowl....	52	56	0	2	17	0
	Cromer Light.....	52	55	30	1	20	0
	Foulness.........	52	56	20	1	20	30
	Hasborough Lts...	52	49	0	1	33	0
	Winterton Ness Lts.	52	43	30	1	42	0
	YARMOUTH	52	36	40	1	43	35
	Leostoff Lights ...	52	29	0	1	46	3
	Southwold	52	20	0	1	40	0
	Aldbro' Knaps....	52	8	0	1	42	0
	Orfordness Light .	52	5	0	1	34	14

II. COAST OF IRELAND.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
West Coast of Ireland.	CAPE CLEAR. .	51	25	30 N	9	29	0 W
	Fastnet Rock.....	51	22	30	9	36	0
	Crookhaven	51	30	0	9	40	0
	Mizzen Head.....	51	29	0	9	46	0
	Bantry Bay,						
	—Sheep's Head...	51	34	0	9	51	0
	Greelagh Rocks ..	51	31	30	10	6	0
	Dursey I. W. end.	51	37	0	10	10	0
	Bull Rock	51	38	0	10	13	0
	Cow Rock	51	37	40	10	12	0
	Kenmare Harbour,						
	—Cod's Head.....	51	43	0	10	4	0
	—Lamb's Head ...	51	49	30	10	5	0
	Var. 2¾ Points W.						
	Hog Islands......	51	49	0	10	10	0
	Boins Head	51	52	30	10	15	0
	Skelling's Rock...	51	52	0	10	29	0
	Lemon Rock	51	53	30	10	23	0
	Dingle Bay,						
	—Bray Head.....	51	59	0	10	21	0
	—Dunmore Head.	52	13	0	10	24	0
	Foze Rock	52	7	30	10	36	0
	Ferriter's Island ..	52	9	0	10	31	0
	Tiraght Rocks....	52	10	30	10	33	0
	Gt. Blaskett, W. end	52	11	0	10	29	0
	Ennis Tuskar.....	52	14	0	10	29	0
	Dunmore Head...	52	13	0	10	24	0
	Dunorling Head ..	52	19	0	10	19	0
West Coast of Ireland.	Brandon Head ...	52	23	0 N	10	6	0 W
	Shannon Mouth,						
	—Kerry Head....	52	30	0	9	54	0
	—Loop Head.....	52	37	0	9	54	0
	LIMERICK	52	42	0	8	41	0
	Clare............	52	51	0	9	2	0
	Hags Head.......	53	0	0	9	23	0
	Galway Bay,						
	—Black Head....	53	10	30	9	11	0
	—GALWAY	53	16	30	8	53	0
	N. Arran I. W. end	53	9	0	9	44	0
	Skird Rocks......	53	16	30	9	56	0
	Sline Head	53	27	0	10	12	0
	Shark I.	53	38	0	10	17	0
	Ennis Turk I.	53	45	0	10	7	0
	Clare I. Light.....	53	52	0	9	58	0
	Achill Head......	54	1	0	10	12	0
	Black Rock......	54	7	0	10	17	0
	—						
	Broad Haven,						
	—Urris Head.....	54	21	0	10	2	0
	Three Tuns Rocks	54	25	30	9	48	0
	Down Patrick Hd.	54	23	0	9	22	0
	Killala...........	54	16	0	9	17	0
	SLIGO	54	21	0	8	34	0
	Ennis Murry Id...	54	31	0	8	45	0
	Donnegal	54	43	0	8	10	0
North Coast of Ireland.	Tillen Head......	54	43	0	8	52	0
	Douras Head.....	54	53	0	8	40	0
	Arranmore I. N. end	55	2	0	8	37	0
	Bloody Foreland..	55	11	0	8	18	0
	Tory Is' N. W. Pt.	55	17	30	8	16	0
	Horn Head	55	15	0	8	1	0
	Melmore Head ...	55	17	0	7	49	0
	Loch Swilly,						
	—Dunaff Head...	55	19	0	7	33	0
	Mullin Head	55	24	0	7	25	0
	Ennistrahul Light.	55	26	30	7	14	0
	Var. 30° W.						
	Inishone Head....	55	14	0	6	55	0
	LONDONDERRY...	54	59	28	7	14	49
	Giants Causeway .	55	15	0	6	24	0
	Rachlin I. W. end.	55	19	0	6	13	0
	Fair Head	55	15	0	6	3	0
	Tor Head........	55	13	0	5	58	0
	—						
	Maids Rocks.....	54	57	0	5	39	0
	Black Head......	54	46	0	5	39	0
	Carrickfergus	54	43	0	5	49	30
East Coast of Ireland.	BELFAST	54	35	0	5	57	0
	Mew I. and Light.	54	40	30	5	24	0
	South Rock Light.	54	21	0	5	24	0
	Dundrum	54	13	0	5	48	0
	Dundalk.........	54	0	0	6	20	0
	Clougher Head ...	53	50	0	6	11	0
	Drogheda Bar....	53	44	0	6	12	0
	St. Patrick's Island	53	35	0	6	3	0
	Lambay Island ...	53	30	0	6	1	0
	Howth Head Light	53	22	0	6	3	0
	DUBLIN. Obs...	53	23	13	6	20	30
	WICKLOW Lights .	52	59	0	6	1	0
	Arklow	52	49	0	6	7	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Glascarrick	52	38	0 N	6	10	0 W
	WEXFORD Harb.	52	22	0	6	19	0
	Carnsore Point	52	11	0	6	18	0
	Tusker Rock	52	12	0	6	7	0
	Var. 28° W.						
	Saltees Rocks	52	6	0	6	36	0
South Coast of Ireland.	Hook Light	52	5	0	6	57	0
	WATERFORD	52	13	0	7	10	0
	Tramore	52	7	0	7	11	0
	Dungarvon	52	4	0	7	39	0
	Ram Head	51	55	0	7	40	0
	Youghall	51	56	0	7	48	0
	Dogs Nose	51	48	0	8	16	0
	CORK	51	53	54	8	28	15
	Var. 28° 10′ W.						
	Kinsale, Light	51	35	0	8	29	0
	Seven Heads	51	33	0	8	42	0
	Dundedy Head	51	32	30	8	56	0
	Ross	51	34	30	8	59	0
	Stags off Toe Head	51	27	0	9	10	0
	BALTIMORE	51	27	0	9	20	0

III. Coast of LAPLAND and NORWAY.

From Nova Zembla to the Naze.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Nova Zembla, N. Pt.	78	5	0 N	76	15	0 E
	Weigates Straits	70	50	0	57	45	0
	Cape Candinose	68	42	0	44	35	0
	Morshom I. S. Pt.	66	40	0	43	27	0
	C. Bona Fortuna	66	31	0	4	54	0
	Blue Point	65	26	0	39	54	0
White Sea.	ARCHANGEL	64	30	36	40	49	15
	Var. 2° West						
	Cape Donega	65	8	0	36	47	0
	Onega	63	54	0	37	58	0
	Cross Island	66	27	0	40	28	0
	Cape Orlogenose	67	14	0	41	22	0
	Lambasche Point	67	52	0	40	40	0
	Cape Sweetnose	68	10	0	40	2	0
	Var. 1° West						
	Nagel Island	68	25	0	37	35	0
	Kilduin Island	69	9	0	34	20	30
Coast of Norway and Lapland.	Wardhuys Island	70	22	36	31	6	45
	NORTH CAPE	71	10	30	26	1	0
	Var. 1 Point W.						
	Altengaard	69	55	0	23	4	0
	Werro Island	67	42	0	11	25	0
	DRONTHEM	63	26	2	10	22	0
	Var. 21° 40′ W.						
	Christian Sound	63	7	0	7	40	0
	Ronde Light	62	24	0	5	35	0
	Askwold	61	22	0	5	7	0
	BERGEN	60	23	40	5	20	0
	Bommel I. S. end	59	34	0	5	10	0
	Stavanger	58	59	0	5	31	0
	Gt Wylingsoe Lt.	59	4	0	5	21	0
	Jedderen Reef	58	45	0	5	26	0
Norway.	Lister Land	58	6	0 N	6	33	0 E
	The NAZE	57	57	50	7	3	15
	Var. 2 Points W.						

IV. The CATTEGAT and SOUND.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	SCAW Light	57	43	44 N	10	37	30 E
	Fladstrand	57	27	3	10	33	15
Jutland.	Sebye	57	20	2	10	32	54
	Aalburg	57	2	32	9	56	30
	Grenaa	56	24	57	10	53	41
	Aarhuys	56	9	35	10	13	50
	Apenrade	55	2	57	9	26	23
	Flensburg	54	47	18	9	27	25
	Sleswick	54	32	0	9	33	0
	The NAZE	57	57	50	7	3	15
	Christiansand	58	8	0	8	3	0
Norway.	Arendad	58	27	0	8	52	0
	Frederickavern	58	59	0	10	7	0
	Ferder Light	59	3	30	10	36	0
	Agero Fort	59	3	0	10	56	0
	CHRISTIANIA	59	55	20	10	48	30
	Frederickstadt	59	12	0	11	1	0
	Stromstadt	58	56	0	11	15	0
	Salo Beacon	58	21	0	11	15	15
	Paternosters	57	55	0	11	27	0
	Marstrand, Light	57	53	51	11	35	45
	GOTHENBURG	57	42	4	11	57	30
	Winga Beacon	57	38	13	11	37	45
	Tislarne	57	30	0	11	44	0
	Niddengen Lights	57	18	20	11	54	45
Sweden.	Warberg	57	6	18	12	15	45
	Falkenburg	56	54	30	12	30	0
	Halmstadt	56	39	45	12	51	45
	Laholm	56	32	38	13	0	45
	Wadero I. S. end	56	26	0	12	35	0
	Engelholm	56	14	20	12	54	0
	Koll Light	56	18	3	12	27	32
	HELSINGBURG	56	2	55	12	43	0
	Landskrone	55	52	27	12	50	46
	Lunden	55	42	26	13	12	27
	Malmo	55	36	37	13	1	4
	Falsterbo Light	55	23	0	12	49	0
	Kioge	55	26	40	12	12	0
	COPENHAGEN	55	41	4	12	35	30
	Var. 18° W.						
Zeeland.	ELSENEUR	56	2	17	12	37	47
	Cronenburg Light	56	2	25	12	37	20
	Nakke Head Lights	56	6	15	12	21	0
	Nykoping	55	55	0	11	40	30
	Callundburg	55	40	54	11	6	18
	Korsar Lights	55	20	22	11	8	30
	Wordingburg	55	1	0	11	57	0
Cattegat.	Huen I. Uraniberg	55	54	38	12	42	44
	Amag I. Drago	55	35	30	12	41	0
	Haselo Island	56	11	46	11	39	46
	Anholt Light	56	44	20	11	39	6

TABLE XLII.

LATITUDES AND LONGITUDES

	Places.	Latitude. °	′	″	Longitude. °	′	″
Cattegat.	Little Mid. Ground	56	57	20 N	11	59	0 E
	Lessoe I. E. end	57	19	0	11	11	30
	—West End	57	15	0	10	53	0
	Trindelen Rock	57	25	0	11	14	0

V. The BALTIC.

	Places.	Latitude. °	′	″	Longitude. °	′	″
	Funen, Odensee	55	24	0 N	10	22	0 E
Danish Isles.	Lanland, Rudkop	54	56	30	10	44	0
	Areo, Kiop	54	53	30	10	26	0
	Alsen, Sonderborg	54	54	59	9	48	29
	Lualand, Naskou	54	51	0	11	15	0
	Falster, Nykoping	54	47	0	11	55	0
	Moen, Stege	54	59	30	12	19	0
	Fermeren, Borge	54	27	0	11	17	0
Sweden.	Tralleborg	55	22	0	13	11	0
	Cimbrishamn	55	33	0	14	21	0
	Ahus	55	55	30	14	18	0
	CARLSCROON	56	6	57	15	32	45
	Torum Point	56	5	0	15	50	0
	Calmar	56	40	30	16	26	0
	Westerwyk	57	44	0	16	41	0
	Soderkoping	58	29	0	16	20	0
	Nykoping	58	45	0	17	3	0
	Trosa	58	53	0	17	33	0
	Landsort Light	58	43	56	17	51	45
	STOCKHOLM	59	20	31	18	3	45
	Var. 1¼ Point W.						
Germany.	Kiel	54	20	0	10	7	0
	LUBECK	53	52	0	10	49	0
	Wismar	53	51	30	11	39	0
	Rostock	54	3	0	12	17	0
	Dars Head	54	28	30	12	36	0
	Gellen Light	54	28	0	13	13	0
	Stralsund	54	18	0	13	12	0
	Usedom	53	53	0	14	5	0
	Wollin	53	48	0	14	44	0
	STETTIN	53	23	0	14	34	0
	Cammin	53	56	0	14	56	0
	Colberg	54	7	0	15	47	0
	Rugenwalde	54	22	0	16	30	0
Prussia.	Heel Light	54	38	0	18	48	0
	DANTZIC	54	21	5	18	38	45
	Pillau	54	34	0	19	54	0
	Konigsberg	54	42	12	20	29	0
	Bruster Ort Lights	54	52	0	19	55	0
	MEMEL	55	42	0	21	5	0
	Libau	56	32	0	20	55	0
	Windau	57	25	30	21	27	0
	Lyserort	57	35	30	21	38	0
	Domesness Lights	57	46	30	22	30	0
Russia.	Runo I. Light	57	48	30	23	7	0
	RIGA	56	56	32	24	2	15
	Pernau	58	21	30	24	20	0

	Places.	Latitude. °	′	″	Longitude. °	′	″
Islands in the Baltic.	Dago, Simperness	59	6	0 N	22	32	0 E
	—Dagerort Light	58	56	1	22	10	0
	Osel, Palmer Ort	58	39	30	22	28	0
	—Hunds Ort	58	32	0	21	50	0
	—Swasve Ort Lt.	57	56	0	22	0	0
	—ARENSBURG	58	15	9	22	27	36
	Gatska Sando	58	26	0	19	18	0
	Faro, N. E. end	57	56	0	19	29	0
	Gottland, N. E. end	57	51	0	19	7	0
	—WISBY	57	39	0	18	26	0
	—Hoborg	56	57	0	18	13	0
	Oland, N. end	57	22	20	17	6	15
	—Borgholms Slott	56	52	0	16	37	0
	—S. end, Light	56	12	40	16	24	15
	Eartholms	55	19	0	15	15	0
	Bornholm N.W. end	55	18	0	14	49	0
	—Hasle	55	10	0	14	47	2
	—S. E. end	54	58	0	15	14	0
	—Svanike	55	8	0	15	16	0
	Rugen, N. end	54	40	0	13	30	0
	—BERGEN	54	24	0	13	32	0
	—S. end, New Deep	54	15	0	13	52	0

VI. The Gulfs of FINLAND and BOTHNIA.

	Places.	Latitude. °	′	″	Longitude. °	′	″
S. Coast in the Gulf of Finland.	Odensholm, Light	59	19	30 N	23	19	0 E
	Great Roge, Light	59	25	0	24	5	0
	Surep Head, Light	59	28	30	24	24	0
	Nargen I. N. Point	59	36	0	24	33	0
	REVEL	59	26	29	24	45	30
	Kokskar Light	59	40	30	25	3	0
	Stone Skar	59	46	0	26	26	0
	Little Titters I.	59	47	0	27	0	0
	Great Titters I.	59	50	0	27	17	0
	Lavenscar, N. end	59	59	0	27	54	0
	Seascar, Light	59	58	30	28	28	0
	Narva	59	20	0	28	24	0
	Dolgenos	59	53	0	29	6	0
	Tolbecon Light	60	0	30	29	39	0
	CRONSTADT	59	59	0	29	49	30
	PETERSBURG	59	56	23	30	19	0
N. Coast in the G. of Finland.	Hango Beacon	59	46	20	22	57	30
	Var. 1 Point W.						
	Helsingfors	60	10	0	25	0	0
	Borgo	60	21	0	25	45	0
	LOVISA	60	25	0	26	26	0
	Orrengrunds Beac.	60	14	0	26	37	0
	Hogland I. Lights	60	3	0	27	7	0
	Aspo	60	14	0	27	22	0
	FREDERICHSHAM	60	30	0	27	25	0
	WIBURG	60	39	0	29	54	0
	Styrs Udden	60	8	30	29	10	0
Bothnia.	Uto Light	59	47	0	21	22	0
	ABO	60	27	7	22	18	30
	Wasa	63	13	0	21	55	0
	Tornea	65	50	50	24	12	0
	Gefle	60	40	0	17	0	0

TABLE XLII.

LATITUDES AND LONGITUDES.

VII. Coasts of DENMARK, GERMANY, HOLLAND, and NETHERLANDS.

From the Scaw to Calais.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
Denmark.	SCAW Light	57	43	44 N	10	37	35 E
	Robsnout	57	25	0	9	45	0
	Oyster Head	57	10	0	8	58	0
	Holmen	57	8	0	8	37	0
	Point Horn	55	37	0	8	3	0
	——						
Germany.	Helegoland Light	54	11	5	7	53	19
	Elbe R. Red Buoy	53	59	30	8	21	30
	Var. 2 Points W.						
	Nework	53	55	39	8	31	29
	Cuxhaven	53	51	40	8	43	30
	Glukstadt	53	47	42	9	26	47
	Stade	53	36	5	9	28	15
	HAMBURG	53	34	8	9	58	0
	Bremerlehe	53	32	30	8	30	0
	BREMEN	53	4	45	8	47	48
	Emden	53	22	0	7	11	0
	Gottingen, obs.	51	32	5	9	56	45
	——						
Holland.	Harlingen	53	10	0	5	25	0
	Texel, S. point	53	2	0	4	33	0
	Alkmaer	52	37	11	4	38	20
	AMSTERDAM	52	22	5	4	53	8
	Haarlem	52	22	16	4	38	30
	Leyden	52	9	25	4	29	0
	The Hague	52	4	12	4	18	25
	Hollands Hook	51	56	0	4	0	0
	ROTTERDAM	51	55	4	4	28	50
	Var. 2¼ Points W.						
	Goeree	51	46	30	3	54	0
	Schowen Lights	51	39	0	3	37	0
	Walcheren I. W. Pt.	51	32	0	3	25	0
	Middleburg	51	30	6	3	37	35
	FLUSHING	51	26	37	3	35	9
	——						
Netherlands.	ANTWERP	51	13	18	4	24	15
	Sluys	51	18	35	3	22	54
	Bruges	51	12	40	3	13	28
	Ostend	51	13	57	2	54	58
	Newport	51	7	54	2	45	0
	Furnes	51	4	23	2	39	36
	DUNKIRK	51	2	11	2	22	23
	Berg	50	57	43	2	26	26
	Gravelines	50	59	10	2	7	35
	CALAIS	50	57	32	1	51	1

VIII. Coasts of FRANCE, SPAIN, and PORTUGAL.

From Calais to Gibraltar.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	CALAIS	50	57	32 N	1	51	1 E
	Cape Grizness	50	52	45	1	34	30
	Ambleteuse	50	48	13	1	36	1
	BOULOGNE	50	43	33	1	36	33
	Etaples	50	30	44	1	38	31
	Montreul	50	27	42 N	1	45	47 E
	Rue	50	16	19	1	40	1
	Le Crotoy	50	12	52	1	27	24
	Abbeville	50	7	4	1	49	43
	S. Valery sur Somme	50	11	21	1	37	36
	Eu	50	2	52	1	15	18
	St. Quintin	50	16	30	1	35	0
	DIEPPE, Light	49	55	34	1	4	29
	Ailly Light	49	55	17	1	10	17
	St. Valery en Caux	49	52	12	0	41	25
	Fecamp	49	45	24	0	22	48
	C. de Caux	49	41	0	0	11	0
	C. de la Heve	49	30	42	0	4	0
	Havre	49	29	14	0	6	23
	Harfleur	49	30	23	0	11	42
	Honfleur	49	25	13	0	13	59
	PARIS, obs.	48	50	15	2	20	15
	Rouen	49	26	27	1	5	35
	Caen	49	11	12	0	21	32 W
	Bayeux	49	16	34	0	42	11
	Carentan	49	18	17	1	15	5
	St. Marcou I.	49	29	52	1	6	56
Northern Coast of France.	C. Barfleur Light	49	41	45	1	16	30
	CHERBOURG	49	38	31	1	37	18
	Pelée Isle	49	40	22	1	34	58
	Cape la Hogue	49	43	33	1	55	30
	Alderney I. N. end	49	45	43	2	12	30
	CASKETT LIGHTS	49	43	30	2	25	10
	Guernsey I. S. Piere	49	25	33	2	33	0
	Sark I. W. end	49	24	32	2	23	45
	Jersey Island,						
	—C. Grossness	49	15	32	2	13	47
	—St. Aubin	49	10	42	2	8	37
	—St. Clement's Pt.	49	9	37	1	59	12
	Chausey Island	48	52	28	1	50	35
	St. Germain	49	13	15	1	35	30
	Coutances	49	2	54	1	26	35
	Granville	48	50	16	1	36	15
	Avranche	48	41	21	1	21	51
	Mount St. Michael	48	38	11	1	31	12
	Pontorson	48	33	18	1	31	32
	Cancalle	48	40	40	1	51	30
	St. Malo	48	39	3	2	1	26
	La Conchée	48	41	4	2	2	48
	Dinant	48	27	6	2	2	5
	Cape Frehel Light	48	41	10	2	19	2
	St. Brieu	48	31	2	2	44	10
	Brehat Island	48	50	5	2	55	48
	Tregueir	48	46	54	3	13	49
	Morlaix	48	34	50	3	53	36
	St. Pol de Leon	48	40	55	4	0	6
	Blanche Rock	49	1	25	3	58	0
	I. de Bas	48	46	15	4	2	0
	St. Anthony's Lts.	48	40	10	4	29	0
	USHANT LIGHT	48	28	8	5	3	21
	——						
	BREST	48	23	14	4	29	0
	St. Matthew's Lt.	48	19	34	4	45	54
	Point Ras	48	0	45	4	47	36
	Saints Rocks	48	5	5	5	3	0
	Point L'Abbe	47	48	40	4	12	0
	Quimper	47	58	29	4	6	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
Western Coast of France.	Glenan Islands ...	47	44	30N	4	0	20W
	Quimperlay	47	51	53	3	33	45
	L'ORIENT........	47	45	11	3	21	17
	Hennebon........	47	48	1	3	17	22
	PORT LOUIS	47	42	47	3	21	14
	Isle of Groas	47	38	4	3	26	23
	QUIBERON, S. Pt..	47	26	30	3	4	0
	Belle I. N. end ...	47	23	0	3	14	0
	—S. end	47	17	17	3	5	0
	Houat Island	47	23	32	2	56	42
	Hedic Island	47	20	46	2	52	31
	Aurai.............	47	40	4	2	49	37
	Vannes	47	39	26	2	45	19
	Guizande	47	19	39	2	26	21
	Croisic	47	17	43	2	30	30
	Painbeuf..........	47	17	15	2	1	46
	NANTES	47	13	6	1	32	59
	Bourgneuf	47	2	28	1	51	24
	Le Pilier..........	47	2	32	2	21	20
	Noirmoutier I. S. Pt	47	0	5	2	14	22
	Bouin Island	46	58	30	2	0	27
	Isle de Dieu, W. Pt.	46	42	26	2	19	50
	St. Gilles	46	40	0	1	51	30
	Olonne Shoals ...	46	29	52	1	47	5
	Roche Bonne.....	46	16	0	2	21	0
	I. of Ree, Lights..	46	14	49	1	33	40
	—St. Martin	46	12	18	1	21	44
	ROCHELLE	46	9	21	1	9	40
	ROCHEFORT	45	56	10	0	57	49
	Oleron I. Tower ..	46	2	50	1	24	58
	Aix Island	46	1	38	1	10	56
	Cordovan Light ..	45	35	14	1	10	10
	Var. 23° *W.*						
	BOURDEAUX	44	50	14	0	34	14
	Cape Feret........	44	43	0	1	14	30
	Cape Breton	43	45	30	1	26	0
	BAYONNE...	43	29	15	1	28	41
	—						
North and West Coasts of Spain.	St. Jean de Luz...	43	23	15	1	40	32
	Fontarabia	43	21	36	1	47	29
	Port de Passages .	43	20	10	1	54	45
	St. Sebastian	43	19	30	1	58	45
	Cape Machicao ...	43	28	10	2	40	0
	BILBOA...........	43	14	30	2	44	0
	Portugalete	43	20	10	2	53	35
	Santona..........	43	26	50	3	18	30
	St. Andero	43	28	20	3	40	0
	Cape Hoyhambre .	43	25	10	4	11	0
	Cape Prieto	43	28	30	4	43	0
	Cape de Mar	43	29	40	4	49	50
	Cape Lastres	43	34	0	5	12	50
	Gijon.............	43	35	19	5	35	0
	Cape Penas	43	42	0	5	45	0
	Cape Busto	43	36	0	6	23	15
	Cape Burol	43	41	30	7	16	35
	Faro Point.......	43	43	15	7	29	0
	Cape Vares	43	47	25	7	34	45
	Pt. de la Estaca ..	43	47	40	7	36	0
	Cape Ortegal.....	43	46	37	7	48	15
	Var. 23° 15′ *W.*						
	Cape Prior.......	43	34	15	8	12	0
West Coast of Spain.	FERROL	43	29	30N	8	[illegible]	15W
	Corunna	43	23	30	8	18	35
	Cape St. Adrian ..	43	21	20	8	47	45
	Cape Villano	43	11	20	9	11	15
	Cape Turiana	43	3	45	9	17	30
	Cape Finisterre...	42	56	10	9	17	0
	Cape Corrobedo ..	42	33	30	9	3	35
	Ons Island, N. Pt.	42	23	45	8	50	45
	VIGO	42	13	10	8	37	0
	Cape Silleiro	42	4	0	8	48	0
	R. Mino, entr.....	41	52	30	8	47	0
	—						
Coast of Portugal	Viana	41	42	0	8	47	0
	OPORTO (entr. to)	41	11	15	8	39	45
	Aveiro...........	40	38	20	8	40	0
	Cape Mondego ...	40	12	0	8	54	20
	Figueira	40	10	0	8	52	0
	Burlings	39	25	0	9	31	11
	Cape Carbœira ...	39	21	0	9	25	11
	Lisbon Rock	38	46	0	9	30	36
	LISBON, obs. ...	38	42	20	9	8	48
	Cape Espichel	38	24	54	9	13	48
	St. Ubes	38	33	0	8	53	30
	Cape Sines	37	57	0	8	54	0
	Cape St. Vincent .	37	2	54	9	0	0
	Var. 2 Points W.						
	Lagos	37	8	0	8	40	0
	Cape Carbonera ..	37	7	0	8	20	0
	Faro.............	37	1	30	7	56	35
	Cape St. Maria ...	36	55	30	7	51	0
	Pt. St. Antony ...	37	9	30	7	19	45
	—						
Spain.	St. Lucar	36	45	30	6	20	0
	SEVILLE	36	59	0	5	58	0
	CADIZ, obs.	36	32	0	6	17	37
	Cape Trafalgar ...	36	10	15	6	0	15
	Tarifa I.	36	0	40	5	35	35
	GIBRALTAR, —Europa Pt......	36	6	40	5	19	45

IX. The North Coast of the MEDITERRANEAN.

	Places.	°	′	″	°	′	″
South and East Coasts of Spain.	GIBRALTAR, —Europa Pt......	36	6	40N	5	19	45W
	Malaga	36	43	30	4	24	15
	Modril...........	36	45	10	3	33	0
	Almeira..........	36	51	20	2	31	0
	Cape de Gatt.....	36	44	0	2	13	0
	Cape Tinoso	37	31	20	1	9	0
	CARTHAGENA	37	35	50	1	0	15
	Cape Palos.......	37	37	15	0	41	0
	Plana I.	38	10	0	0	28	45
	Alicante	38	20	0	0	29	0
	Cape St. Martin ..	38	47	30	0	10	45E
	Denia	38	52	0	0	5	15
	Valencia.........	39	26	30	0	22	0W
	Cape Oropesa	40	6	0	0	8	0E
	River Ebro, entr. .	40	42	0	0	57	0
	Tortosa..........	40	48	0	0	32	15

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Terragona	41	8	50 N	1	19	15 E
	BARCELONA	41	23	8	2	11	45
	Var. 21° 0′ *W.*						
	Cape de Tosa	41	43	0	2	55	0
	Palamos	41	52	0	3	4	0
	Cape St. Sebastian	41	53	20	3	9	15
	Bay of Roses	42	16	0	3	7	0
	Cape Creux	42	19	45	3	17	0
	—						
	Callioure	42	31	31	3	5	2
	Perpignan	42	41	59	2	53	35
	Cape Leucate	42	54	0	3	6	0
	Narbonne	43	10	58	2	59	59
	Agde	43	18	43	3	27	55
	Fort Brecon	43	15	38	3	30	3
	CETTE Lights	43	23	41	3	41	46
	Montpelier	43	36	29	3	52	25
	Aigues, Light	43	34	8	4	11	44
South Coast of France.	Arles	43	40	28	4	37	24
	Avignon	43	56	58	4	48	10
	Aix	43	31	48	5	26	32
	MARSEILLES	43	17	49	5	21	43
	La Ciotat	43	10	30	5	36	49
	Sixfours	43	6	3	5	50	7
	TOULON	43	7	16	5	55	26
	Hieres	43	7	20	6	7	11
	Gien	43	2	19	6	7	15
	Cape Taillar	43	7	30	6	43	30
	Frejus	43	25	49	6	43	52
	St. Tropez	43	16	27	6	38	29
	Cape Roux	43	22	30	7	2	30
	Cannes	43	32	51	7	0	16
	Antibes	43	34	43	7	7	20
	St. Marguerite, I.	43	31	24	7	2	30
	NICE	43	41	47	7	16	22
	Ville Franche, Lt.	43	40	20	7	19	15
	—						
	Cape Melle	43	57	0	8	8	0
	Savona	44	17	0	8	30	0
	GENOA	44	25	0	8	58	0
Genoa.	Rappallo	44	21	0	9	16	0
	Point Venere	44	5	0	9	45	0
	Spezia	44	8	0	9	44	0
	Pisa	43	43	7	10	23	45
	FLORENCE	43	46	30	11	13	30
	LEGHORN	43	33	2	10	16	30
	Var. 19° *W.*						
	Vado Tower	43	25	0	10	23	0
	Piombino	42	55	27	10	30	47
	Cape Troy	42	46	0	10	41	0
West Coast of Italy.	Civita Vecchia	42	5	24	11	44	30
	Ostea	42	45	0	12	17	0
	ROME	41	53	54	12	27	30
	Cape Danso	41	26	0	12	38	0
	Mount Cercello	41	12	0	13	1	0
	Gaeta	41	15	0	13	38	0
	NAPLES	40	50	15	14	11	30
	Salerno	40	44	0	14	46	0
	Cape Licosa	40	15	0	14	57	0
	Policastro	40	6	0	15	40	0
	St. Euphemia	38	55	0	16	32	0

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Tropea	38	36	0 N	16	7	0 E
	Reggio	38	7	0	15	55	0
	Pta. Saeta	37	51	0	15	58	0
	—						
	Cape Spartivento	37	53	0	16	22	0
	Cape Stillo	38	23	0	16	55	0
	Catanzaro	38	50	0	16	55	0
	Cape Colonne	39	4	0	17	28	0
	Point Alice	39	24	0	17	25	0
	TARENTO	40	28	0	17	30	0
	Gallipoli	40	2	0	18	10	0
	Cape St. Mary	39	49	0	18	26	0
	Otranto	40	8	0	18	36	0
	Brindisi	40	39	0	18	8	0
	Cape Cavallo	40	43	0	18	14	0
Gulf of Venice.	Bari	41	7	0	17	0	0
	Manfredonia	41	37	0	16	5	0
	Viesti	41	54	0	16	15	0
	Termoli	41	58	0	15	6	0
	Ortona	42	18	0	14	27	0
	Loretto	43	27	0	13	36	0
	ANCONA	43	37	54	13	28	52
	Var. 17° *W.*						
	Rimini.	44	3	43	12	32	36
	Pesaro	43	53	0	12	53	0
	Ravenna	44	24	0	12	10	0
	Comachio	44	40	27	12	9	47
	VENICE	45	25	35	12	20	45
	Trieste	45	45	0	13	47	0
	Rovigno	45	9	0	13	47	0
	Segua	45	0	0	15	10	0
	Zara	44	9	0	15	29	0
	Cape Sesto	43	34	0	16	7	0
	—						
	RAGUSA	42	40	0	18	9	0
	Cattaro	42	27	0	18	29	0
	Scutari	41	53	0	19	14	0
	Durazzo	41	18	0	19	27	0
	C. Linguetta	40	26	0	19	15	0
	Butrinto	39	43	0	20	3	0
	St. Nicholas	39	24	0	20	26	0
	Lepanto	38	16	0	22	1	0
	Coron	36	47	26	21	58	37
Turkey in Europe.	C. Matapan	36	23	20	22	29	15
	C. St. Augeli	36	27	0	23	12	0
	Corinth	37	53	24	23	2	22
	ATHENS	37	58	1	23	45	59
	Negropont	38	27	0	23	44	0
	Cape Doro	38	9	0	24	40	0
	Cape St. George	39	25	0	23	17	0
	SALONICA	40	38	7	22	55	28
	Cape Cassandra	39	56	0	23	16	0
	Mount Athos	40	7	0	24	15	0
	Contessa	40	39	0	23	58	0
	Cape Macri	40	30	0	25	38	0
	Eno	40	42	0	26	0	0
	The Dardanelles	40	3	0	26	6	0
	Gallipoli	40	25	33	26	37	15
	Rodosto	41	0	0	27	26	0
	CONSTANTINOPLE	41	1	27	28	55	0

LATITUDES AND LONGITUDES.

X. The BLACK SEA and SEA OF AZOF.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Ismayl	45	21	0 N	29	4	0 E
	Akerman	46	11	0	30	29	0
	Odessa	46	29	0	30	50	0
	Kherson	46	38	29	32	32	15
	Koslof	45	11	0	33	22	0
	Sevastopol	44	41	0	33	20	0
	Yenicale	45	22	0	36	33	0
	Fanagoria	45	11	0	36	34	0
	Taganroy	47	12	0	38	47	0
	Trebizonde	41	2	0	39	37	0
	Cape Yassoun	41	11	0	37	45	0
	Sinope	42	3	0	35	9	0

XI. South Coast of the MEDITERRANEAN.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Scutari	41	0	0 N	29	0	0 E
	Moudania	40	14	0	29	0	0
	Troy	39	45	0	26	5	0
	Cape Baba	39	28	0	25	58	0
	Adramitta	39	32	0	26	48	0
	SMYRNA	38	25	7	27	6	33
Turkey in Asia.	*Var.* 14° 15′ *W.*						
	Cape Blanc	38	15	0	26	5	0
	Cape St. Mary	37	42	0	26	48	0
	Cape Crio	36	42	0	27	14	0
	Marmorice	36	48	0	28	11	0
	Macri	36	36	0	29	7	0
	Seven Capes	36	23	0	29	3	0
	Kasteloriza I.	36	8	0	29	30	0
	Cape Chelidoni	36	12	0	30	20	10
	Adalia	36	52	0	30	40	0
	C. Anamour	36	1	0	32	44	0
	Cape Cavaliere	36	7	0	33	38	0
	Cape Karadash	36	34	0	35	18	0
	ALEXANDRETTA, or Scandaroon.	36	34	47	36	5	45
	Cape Ziaret	35	37	0	35	34	0
	ALEPPO	36	11	25	37	10	0
Syria, or the Levant.	Tartosa	34	58	0	35	54	0
	Tripoli	34	32	0	35	33	0
	Beiroutte	33	50	0	35	30	0
	Cape Blanco	33	10	0	35	8	0
	ACRE	33	0	0	35	10	0
	Var. 15° *W.*						
	Mount Carmel	32	50	0	35	8	0
	Caesaria	32	32	0	35	0	0
	Jaffa	32	5	0	34	50	0
	Gaza	31	30	0	34	36	0
	El Arish	31	8	0	34	3	0
	DAMIETTA	31	25	40	31	49	45
	Cape Bourlos	31	36	0	31	27	0
	ROSETTA	31	24	34	30	58	36
	ABOUKIR	31	18	0	30	38	0
	Bequiere, or Nelson's Island	31	21	0 N	30	39	0 E
	CAIRO	30	2	21	31	18	30
Coast of Egypt.	ALEXANDRIA	31	11	20	30	16	20
	Var. 16° *W.*						
	Cape Deras	31	11	0	28	15	0
	Calleta Island	31	6	20	27	20	0
	Cape Rameda	31	22	0	25	42	0
	Cape Luco	31	48	0	25	2	0
	Cape Trabuco	32	0	0	24	7	0
	Cape Batraca	32	15	0	23	40	0
	Cape Derne	32	46	0	22	40	0
	Cape Razat	33	5	0	21	48	0
	Cape Carcorella	31	39	0	19	20	0
	Cape Mezurat	32	22	0	15	40	0
	Cape Tajora	32	59	0	13	22	0
	TRIPOLI	32	53	40	13	21	7
	Cape Gergis	33	57	0	11	30	0
Lybia.	Cape Paul	35	10	0	10	58	0
	Susa	35	49	0	10	25	0
	Cape Bon	37	5	30	11	5	30
	TUNIS	36	42	0	10	22	0
	Var. 19° *W.*						
	Cape Carthage	36	55	0	10	28	0
	Bizerta	37	20	0	9	59	0
	Cape Negro	37	12	0	9	7	0
	Bona	37	48	0	7	52	0
	Cape Fierro	37	2	0	7	20	0
	Cape Bagaroni	37	11	0	6	38	0
	Cape Tedeles	36	53	0	4	14	48
Coast of Barbary.	Cape Matetor	36	47	10	3	18	20
	ALGIERS	36	48	36	3	1	5
	Cape Tenis	36	34	0	1	26	0
	Cape Ferrat	35	54	0	0	13	0 W
	Oran, Castle	35	44	27	0	39	45
	Cape Falcon	35	47	0	0	48	0
	Cape Fegalo	35	31	0	1	10	0
	Zaffarine Islands	35	12	0	2	24	0
	Melilla	35	18	15	2	57	35
	Cape Tres Forcas	35	27	55	2	57	25
	Mostaza	35	9	0	4	32	0
	Tetuan	35	36	0	5	24	0
	Var. 21° *W.*						
	Ceuta	35	54	4	5	16	24
	TANGIER	35	40	0	5	49	0
	Cape Spartel	35	48	40	5	53	25

XII. Islands in the MEDITERRANEAN, GULF OF VENICE, and ARCHIPELAGO.

Places.	Latitude.			Longitude.		
Alboran	35	57	0 N	3	0	55 W
Fromenterra,						
—East Point	38	42	0	1	36	0 E
—West Point	38	37	0	1	24	0
Yvica, N. E. Point	39	2	0	1	37	0
—S. W. Point	38	50	0	1	13	0
Colambretes	39	55	0	0	32	0
Cabrera	39	8	0	3	0	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
Majorca.	N.E.Pt.C.Pollenza	39	57	0 N	3	14	0 E
	S. Point, C. Salini.	39	16	0	3	6	0
	E. Point, C. Pedro	39	42	0	3	29	0
	Dragon Island....	39	33	0	2	20	0
	PALMA	39	33	0	2	39	45
	——						
	Minorca, C. Bajoli	40	4	0	3	52	30
	—PORT MAHON ..	39	51	48	4	18	30
	——						
Sardinia.	N. Pt. Lagosardo	41	18	0	9	12	0
	Cape Asinara.....	41	5	40	8	17	19
	Porto Conte......	40	33	30	8	16	0
	Oristana, N. Point	39	52	38	8	20	30
	——— S. Point.	39	47	40	8	24	0
	Maldeventro, I....	39	58	46	8	22	0
	Rock Gallia	39	53	43	8	19	15
	St. Peter's Island..	39	6	42	8	14	0
	Toro Rock	38	52	0	8	20	0
	Cape Malfetena...	38	53	0	8	51	0
	CAGLIARI........	39	13	0	9	8	0
	Var. 19° 36′ *W.*						
	Cape Carbonera ..	39	10	0	9	30	0
	Olaster	39	58	0	9	40	0
	Cape Cavallo	40	49	0	9	40	0
	Tavolara.........	40	54	46	9	43	13
	——						
Corsica.	Cape Corse.......	43	3	0	9	20	0
	Saint Fiorenzo....	42	39	0	9	18	0
	Calvi	42	34	7	8	45	1
	Ajacio	41	55	1	8	43	49
	Bonifacio	41	23	13	9	9	1
	South Point	41	22	0	9	14	0
	Cape Signo.......	42	32	0	9	32	0
	BASTIA	42	42	36	9	26	30
	——						
	Gorgona	43	25	46	9	53	55
	Capraria	43	0	18	9	48	57
	Elba, Port Ferraro	42	50	0	10	22	0
	Pianosa..........	42	39	0	10	8	0
	Formigues........	42	21	30	10	6	30
	Monte Christo	42	20	0	10	17	0
	Gilio, South Point	42	27	0	10	58	0
	Palmarora	40	57	0	12	47	0
	Pozea, South Point	40	53	0	12	55	0
	Ischia, South Point	40	42	0	13	51	0
	Capri............	40	32	0	14	15	0
	——						
Sicily.	MESSINA.........	38	11	0	15	44	0
	Cape Orlando	38	3	0	14	57	0
	Cape Cefala	38	4	0	14	5	0
	PALERMO........	38	6	45	13	21	15
	Cape St. Vito.....	38	13	0	12	45	0
	Tripano..........	38	2	0	12	28	0
	Gargento	37	14	0	13	38	0
	Cape Alicante	37	3	0	14	5	0
	Cape Secha	36	49	0	14	26	0
	Cape Passari	36	36	0	15	8	0
	Saragossa	37	2	0	15	20	0
	Cape Carnali	37	10	0	15	23	0
	Catania	37	26	0	15	15	0
	Cape Moline	37	30	0	15	24	0
	——						
	Stromboli	38	48	0 N	15	24	0 E
	Lipari, South Point	38	27	0	15	10	0
	Salini............	38	32	0	15	5	0
	Felicuri..........	38	34	0	14	47	0
	Alicuri...........	38	33	0	14	32	0
	Maritimo	38	3	29	12	12	0
	Favognana	38	2	0	12	33	0
	Marsalla Shoal, —Outer end......	37	45	0	12	41	0
	Galiti, Center .	37	32	30	8	55	0
	Esquerque	37	47	0	10	39	0
	Keith's Reef......	37	51	24	10	59	0
	Pantellaria	36	51	0	12	17	0
	Linoza...........	35	51	0	13	0	0
	Lampidosa, E. Pt.	35	29	0	12	40	0
	Sioglea Rock	36	59	0	12	31	0
	Gozo, N. W. Point	36	12	0	14	5	0
	Malta, La Valette.	35	53	41	14	30	30
	Var. 17° *W.*						
	——						
	Fano	39	50	0	19	20	0
Gulf of Venice.	Pelagosa.........	42	29	0	16	24	0
	Pianosa..........	42	12	0	15	55	0
	Tremiti	42	7	0	15	40	0
	Lissa, South Point.	43	3	0	16	25	0
	Pomo............	43	14	0	15	35	0
	Paxu, South Point	39	12	0	20	10	0
	Corfu, Town	39	36	0	19	55	0
	Cefalonia, S. Point	38	1	0	21	3	0
	—N. Point	38	36	0	20	42	0
	Zante, S. Point...	37	35	0	20	57	0
Archipelago.	Cerigo, S. Point ..	36	9	0	22	57	0
	Cerigotto	35	51	0	23	14	0
	Milo, Town	36	41	3	24	25	0
	Santorin, S. Pt. ...	36	19	0	25	28	0
	Paros, Town	37	5	0	25	11	0
	Scio, Town	38	24	0	26	0	0
	Mytelene, Town ..	39	6	0	26	21	0
	—Sigri	39	13	0	25	41	0
	Tenedos	39	54	0	25	56	0
	Lemnos..........	39	54	0	24	53	0
	——						
Candia.	Cape Crio........	35	12	0	23	33	0
	Cape Busa	35	38	0	23	35	0
	Canea	35	28	45	24	12	30
	Cape Sassosa	35	26	0	25	12	0
	CANDIA.........	35	18	45	25	18	0
	Cape Sidera......	35	15	0	26	38	0
	Cape Salamone ...	35	0	0	26	40	0
	——						
	Goza, S. Point. .	34	35	0	24	20	0
	Goxa, S. Point...	35	30	0	27	2	0
	Scapanto.........	35	40	0	27	10	0
	Rhodes, Town....	36	32	0	28	18	0
	—South Point	35	52	0	27	50	0
	——						
Cyprus.	Cape St. Andrew .	35	35	0	34	40	0
	Cape Cormachiti..	35	40	0	32	51	0
	Cape St. Epiphanes	35	28	0	32	7	0
	Cape de Gatt.....	34	38	0	33	0	0
	Cape Grego	34	55	0	33	52	0

LATITUDES AND LONGITUDES.

XIII The Coast of AFRICA, from the Entrance of the Mediterranean to the Cape of Good Hope.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	CAPE SPARTEL...	35	48	40N	5	53	25W
Fez.	Larash...........	35	11	0	6	12	0
	NewSalee, or Rabat	34	5	0	6	43	30
	Mazagan.........	33	20	0	8	25	0
	Cape Blanco	33	10	0	8	40	0
Morocco.	Cape Cantin......	32	33	0	9	15	0
	Saffia............	32	20	0	9	9	0
	MOGADORE I.	31	25	0	9	36	0
	Cape Geer	30	38	0	9	52	0
	Cleveland Shoal...	30	45	0	10	21	0
	Santa Cruz	30	30	0	9	38	0
Azenhegi.	Cape Nun........	28	39	0	11	15	0
	Entr. of River Nun	28	17	0	11	31	0
	Cape Blanca	27	54	0	12	42	0
	Cape Bajador	26	12	30	14	27	0
	Entr. of Rio do Ouro	23	32	0	15	50	0
	Cape das Barbas..	22	15	30	16	40	0
Hagi.	Cape Blanco	20	55	30	17	10	0
	Cape St. Ann	20	36	0	16	45	0
	Cape Myrick	19	5	0	16	25	0
	Portendick.......	18	7	0	16	12	0
Senegal.	Point de Breberie, entr. to Senegal.	15	53	0	16	31	30
	St. Lewis Island ..	16	3	30	16	28	0
	CAPE VERD......	14	44	13	17	31	16
	Var. 15° 50′ *W.*						
	Goree Island, Fort	14	39	30	17	24	30
	Cape Naze	14	34	0	17	12	30
Senegambia.	River Gambia, —Cape St. Mary..	13	8	0	16	33	0
	James Fort.......	12	56	0	16	15	0
	Cape Roxo.......	12	12	0	16	40	0
	Cape Verga	10	5	0	13	55	0
	Delos Is. Factory .	9	22	0	13	32	0
	Leopards I.	8	40	10	13	8	0
	C. SIERRA LEON .	8	29	30	13	9	17
	Var. 14° 31′ *W.*						
	Cape Shilling	8	9	0	12	52	0
	Banana I.	8	5	30	13	5	0
	Tassa Point	7	41	0	12	39	0
	Cape Ann	7	17	30	12	22	0
	Cape Mount......	6	45	0	11	18	0
	Var. 15° 27′ *W.*						
Grain Coast.	Cape Mesurada ...	6	16	20	10	35	0
	Grand Bassa	5	52	0	9	55	0
	River Sestos......	4	39	0	9	40	0
	Sangwin	5	12	0	8	56	0
	Krou Settra	4	54	0	8	32	0
	Grand Sisters......	4	41	0	8	7	0
	Cape Palmas	4	23	0	7	38	0
	Var. 17° 30′ *W.*						
	Tabou Point	4	28	0	7	8	0
	St. Andrew's River	5	0	0	6	4	0
	Cape Lahou......	5	10	0	4	37	0

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Grand Bassam....	5	17	0N	3	27	0W
Ivory Coast.	Cape Appollonia ..	4	59	12	2	40	11
	AXIM	4	57	0	2	23	0
	Cape Three Points	4	55	0	2	2	0
	Dixcove Fort......	5	0	0	1	54	44
	Secondee.........	5	5	0	1	45	0
	St. Sebastian's Fort	5	7	0	1	33	0
	Elmina Castle	5	1	38	1	15	12
Gold Coast.	C. Corse Castle ...	5	3	45	1	3	0
	Annamaboe	5	8	30	0	56	0
	Kormantine Fort..	5	7	58	0	51	0
	Tantumquerry Pt..	5	7	0	0	45	0
	Barracoe Point ...	5	21	30	0	22	0
	Accarah	5	30	30	0	12	0
	Ningo	5	43	0	0	28	0
	Adda Castle......	5	48	0	0	44	0
	Cape St. Paul's ...	5	44	0	1	7	0
	Quitta	6	2	0	1	17	0
	Little Popoe	6	12	0	2	2	0
	Whydah	6	17	0	2	32	0
Benin.	Lagos	6	20	0	4	12	0
	River Formosa....	5	43	0	5	25	0
	Cape Formosa	4	25	0	5	59	0
	New Calabar River	4	25	0	7	42	0
	Cameroons River .	3	45	0	9	35	0
	Cape St. John	1	15	0	9	15	0
	Gabon R. C. Clara	0	25	0	9	20	0
Biafra.	Cape Lopez	0	59	0S	9	35	0
	Low Point	2	0	0	9	37	0
	River Seste	2	25	0	10	24	0
	Cape Mayumba...	3	36	0	11	14	0
	Var. 19° 0′ *W.*						
	Loango Bay......	4	36	0	12	20	0
	C. Padron, entr. to Congo River ...	6	16	0	12	37	0
Loango.	*Var.* 21° 30′ *W.*						
	Ambriz Bay......	7	56	0	13	15	0
	Dande...........	8	38	0	13	47	0
	Cape Ledo	9	48	0	13	28	0
	Novo Redondo ..	11	20	0	14	5	0
	Var. 21° 20′ *W.*						
	S. Phil. de Benguella	12	33	0	13	29	0
	Cape Negro	16	1	0	11	54	0
	Tigers Island, N. pt.	16	29	45	12	3	0
	Cape Frio........	19	15	0	12	56	0
	Village	21	53	51	14	40	0
	Walwich Bay.....	22	53	50	14	40	0
	Var. 21° 30′ *W.*						
	Ilea Point........	23	30	0	14	48	0
	Bird I.	24	36	0	14	50	0
	Angra Pequena ...	26	36	50	15	16	30
Caffraria.	Cape Voltas	28	42	0	16	20	0
	St. Helen's Bay, —Cape St. Martin	32	40	0	17	53	0
	Saldanah Bay	33	7	0	17	58	0
	Dassen Island	33	24	0	18	3	30
	Table Bay, Robin I.	33	48	0	18	23	0
	—Town..........	33	56	15	18	28	30
	C. of GOOD HOPE.	34	23	40	18	32	15
	False Cape	34	25	0	18	52	0
	Var. 25° 40′ *W.* 1800						

TABLE XLII.

LATITUDES AND LONGITUDES.

XIV. Islands, Rocks, and Shoals, in the NORTH ATLANTIC OCEAN, and SOUTH ATLANTIC, or SOUTHERN OCEAN.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Lion's Bank	56	40	0 N	17	45	0 W
	Rockal	57	39	30	13	31	0
	Atkins Shoal	55	18	0	11	15	0
	Chapel Rock	47	28	0	7	30	0
	Devil's Rocks	46	25	0	13	0	0
	Sisk's Shoal	40	43	0	23	37	0
	Gough's Rocks....	40	25	0	33	0	0
	Hamond's Rock...	36	45	0	23	10	0
	Steen Ground	32	45	0	21	25	0
	Josna Rock	31	37	0	23	45	0
	Bermudas I. Town	32	22	0	64	33	0
	———						
	Corvo, South Point	39	40	45	31	7	31
	Flores, Pt.Delgada	39	33	0	31	7	17
	Fayal, S. E. Point.	38	30	55	28	41	36
Azores, or Western Islands.	Pico,						
	—Point do Espertal	38	26	0	28	35	0
	—Summit of Peak	38	27	0	28	28	0
	—East Point	38	22	0	28	6	20
	St.George, S.E.Pt.	38	30	45	27	50	30
	Graciosa,						
	—Villa da Praya..	39	2	30	28	1	0
	Terceira, ANGRA .	38	38	10	27	12	33
	St. Michael,						
	—Pta. Delgada...	37	45	0	25	41	40
	—Pta. Ferraria ...	37	54	15	25	53	17
	—North East Point	37	48	40	25	11	0
	Formigas, or Ants.	37	17	10	24	53	33
	St. Mary, TOWN..	36	57	40	25	12	20
	—West Point.....	36	57	0	25	14	3
	—Puntada Castello	36	56	10	25	5	30
	———						
	Porto Santo, Town	33	3	15	16	17	15
Madeira Isles.	Madeira,						
	—Lorenzo Point ..	32	43	0	16	37	0
	—Tristam Point ..	32	54	0	17	15	30
	—FUNCHAL	32	37	30	16	55	0
	Var. 17° 55′ *W.*						
	S. Dezertos,						
	—South Point	32	22	0	16	28	0
	Salvages, Middle..	30	8	15	15	53	0
	Piton	30	1	38	16	5	38
	Var. 18° 23′ *W.*						
	———						
Canary Isles.	Palma, Town.....	28	43	0	17	46	0
	—North Point....	28	52	30	17	56	0
	—South Point	28	29	30	17	53	30
	Ferro, Valverde ..	27	47	35	17	55	0
	—North End	27	50	30	17	58	0
	Gomero,						
	—St. Sebastian ...	28	5	40	17	8	0
	Teneriffe,						
	—Hidalgo Point ..	28	40	0	16	21	0
	—Orotava.........	28	23	35	16	35	35
	—Tena Point.....	28	19	30	16	56	0
	—PEAK..........	28	16	38	16	39	33
	—Port Christianos	28	3	0 N	16	44	0 W
	—SANTA CRUZ ...	28	28	30	16	16	30
	Var. 19° 12′ *W.*						
	Canary, N.E. Point	28	13	0	15	25	45
Canary Isles.	—Palmas	28	8	0	15	29	0
	—South West Point	27	45	0	15	38	30
	Fuerteventura,						
	—Point Gorda....	28	46	0	13	52	30
	—South West Point	28	4	0	14	31	30
	Lanzarote, S. Point	28	51	0	13	45	0
	—Puerto de Naos.	28	58	30	13	34	0
	—Punta del Farion	29	14	0	13	30	0
	Graciosa	29	14	0	13	34	0
	St. Claire	29	17	0	13	33	0
	Alegranza	29	25	30	13	31	0
	———						
Cape Verd Islands.	St. Antonio,						
	—SANTA CRUZ ...	17	1	40	25	8	15
	—South End	16	54	50	25	22	0
	St. Vincent Town	16	53	30	25	3	0
	St. Lucia, S. Point	16	44	30	24	48	40
	St. Nicholas, N. Pt.	16	41	30	24	24	20
	—East Point	16	34	30	24	3	0
	Salt I. South Point	16	34	25	23	0	0
	Bonavista. N. Point	16	13	40	22	59	30
	Mayo Town.....	15	7	30	23	17	0
	St. Jago,						
	—PORT PRAYA ..	14	53	40	23	34	0
	Var. 10° 48′ *W.*						
	Fogo, North Point	15	1	20	24	25	0
	Brava, South Point	14	45	58	24	46	0
	———						
	PenedodeSt.Pedro,						
	or St. Paul's	0	55	0	29	30	0
	Fernandez Po,						
	—N. W. Bay	3	28	0	7	36	0 E
	Princes' Island ..	1	36	0	7	27	0
	St. Thomas's Isle..	0	27	0	6	42	30
	St. Matthew's	1	55	0 S	9	25	0 W
	Annabona, N. end.	1	23	0	5	34	0 E
Islands in the South Atlantic.	Ascension	7	55	0	14	15	50 W
	ST. HELENA,						
	—James Town ...	15	55	0	5	43	30
	Fernd. de Noronha	3	55	15	32	35	20
	Roccas	3	52	40	33	31	0
	Abrolhos Is.......	17	58	0	38	26	0
	Trinidad I........	20	32	30	29	9	30
	Martin Vas.......	20	28	30	28	41	0
	Tristan de Cunha .	37	6	0	11	44	0
	Inaccessible I.....	37	19	0	11	50	0
	Nightingale I.	37	29	0	11	48	0
	Diego Alvarez....	38	53	0	10	40	0
	Gough's Island ...	40	19	30	9	41	15
	Lennon's Reef	37	31	0	4	42	0
	Isle Grande	43	0	0	30	0	0
	Falkland Islands,						
	—Port Egmont ...	51	24	0	59	56	0
	—Cape Percival ..	51	45	0	61	28	0
	Berkley Sound ent.	51	32	0	57	25	0
	Aurora Isles,						
	—Northernmost ..	52	43	0	48	12	0
	—Southernmost...	53	18	0	48	2	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
S. Georgia.	Cape North	54	4	45 S	38	15	0 W
	Cape George	54	17	0	36	32	30
	Cooper's Island	54	57	0	36	4	20
	Clerk's Islands	55	5	30	34	42	0
Sandwich Ld.	Candlemas Islands	57	5	30	27	13	0
	Cape Montague	58	33	0	26	46	0
	Friesland Peak	59	2	0	26	55	30
	Southern Thule	59	34	0	27	45	0
S. Shetland.	Smith's Cape	62	52	0	63	45	0
	Start Point	62	42	0	61	27	0
	Cape Sherriff	62	26	0	60	54	0
	Ridley's Island	61	49	0	58	22	0
	Seal Islands	61	0	0	55	34	0
	Clarence I. N. Pt.	61	2	0	54	5	0

XV. The Coast, and adjacent Islands, from the CAPE OF GOOD HOPE to CANTON.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
Eastern Coast of Africa.	C. of Good Hope	34	23	40 S	18	32	15 E
	Var. 25° 40′ *W.* 1800						
	False Cape	34	25	0	18	52	0
	Cape Agulhas	34	55	30	20	18	0
	Cape Infante	34	35	0	20	54	0
	Cape Vaccas	34	25	0	22	5	0
	Cape St. Blass	34	10	0	22	18	0
	Cape Delgado	34	6	30	23	48	0
	Alagoa Bay, —Cape Recife	34	2	0	25	42	0
	Var. 26° 40′ *W.* 1797						
	Point Padraon	33	39	0	26	34	0
	First Pt. of Natal	32	22	0	29	25	0
	Middle Pt. of Natal	31	8	0	30	45	0
	Third Pt. of Natal	30	15	0	31	22	0
	Port Natal	29	55	0	31	28	0
	Point St. Lucia	28	36	0	32	48	0
	Cape Smoke	27	13	0	33	15	0
	Delagoa Bay, —English River	25	58	0	32	41	0
	Var. 28° 7′ *W.* 1802						
	Cape Corrientes	24	2	0	35	51	0
	Cape St. Sebastian	22	5	0	35	58	0
	Bazaruto Is. N. end	21	30	0	36	2	0
	Sofala (Fort)	20	15	15	34	45	0
	Quilimaney	18	10	0	37	30	0
	Angoxa Is., —Mafamede	16	21	30	40	25	30
	MOZAMBIQUE	15	1	30	40	46	38
	Var. 18° 40′ *W.* 1802						
	Cape Delgado	10	9	0	40	50	0
	Quiloa	8	41	0	39	47	0
	Zanzibar Is.	6	6	0	40	15	0
	Mombas	4	0	0	40	34	0
	Juba	0	12	0	43	2	0
	Brava	1	10	0 N	44	20	0
	Magadoxa	2	6	0	46	30	0
	Cape Bassas	5	0	0	49	20	0
	Cape Orfui	10	26	0	51	38	0
	Cape Guardafui	11	50	0	51	32	0
	Mount Felix	12	0	0	50	48	0
	Mette Island	11	20	0 N	48	52	0 E
	Burnt Island	11	22	0	47	50	0
	Barbora	10	25	0	45	8	0
	Cape Rasbel	12	4	0	43	51	0
	Socotra I. E. Point	12	22	0	54	53	0
The Red Sea.	Babelmandel I.	12	36	0	43	29	0
	Babelmandel Cape	12	40	0	43	32	0
	Var. 8° 45′ *W.* 1799						
	Ras Rattah	14	56	0	40	52	0
	Dhalak I.	15	32	30	40	15	0
	Massowah Bay	15	34	0	39	37	0
	Port Mornington	18	16	0	38	32	0
	Suakin	19	5	0	37	33	0
	Salaka	20	28	0	37	27	0
	Cape Calmez	21	28	0	37	25	0
	Cape Nose	23	58	0	35	42	0
	St. John's I.	23	38	0	36	10	0
	Reef of Breakers	24	4	0	36	16	0
	Dedalus Shoal	24	58	0	35	56	0
	Centurion Shoal	25	20	0	35	48	0
	Cosire	26	8	0	34	15	0
	SUEZ	30	0	30	32	28	0
	Var. 12° 0′ *W.* 1800						
	Tor Harbour	28	19	0	33	28	0
	Ras Mahomed	27	43	0	34	15	0
	Bareedy Harbour	24	17	0	37	45	0
	Yambo	24	10	0	38	21	0
	Juddah	21	29	0	39	15	0
	Camfidia	19	7	0	40	50	0
	Marabia Reefs, —Western Part	19	11	0	40	5	0
	Loheia	15	44	0	42	44	0
	Cape Israel	15	15	0	42	41	0
	Gebel Tor	15	32	0	42	0	0
	Var. 8° 30′ *W.* 1801						
	Gebel Zebayr	15	3	0	42	18	0
	Gebel Zeghir	14	2	0	42	52	0
	Mocha	13	20	0	43	20	0
	Var. 1 *Point W.*						
Coast of Arabia	Cape St. Anthony	12	42	0	44	43	0
	Cape Aden	12	45	0	45	10	0
	Cape Bogashua	14	10	0	49	26	0
	Kisseen Point	15	19	0	51	25	0
	Cape Fartash	15	35	0	51	56	0
	Cape Morebat	17	0	0	54	32	0
	Cape Chansely, or St. Pedro	18	2	0	56	27	0
	Cape Isolette	19	0	0	57	48	0
	Mazeira I. N. pt.	20	45	0	58	57	0
	Cape Rosalgate	22	22	0	60	0	0
	Var. 5° 42′ *W.*						
	Muscat	23	38	0	58	40	0
G. of Persia.	Cape Musseldom	26	21	0	56	38	0
	Var. 9° *W.*						
	Cape Jasques	25	38	0	58	10	0
	Gambaroon	27	13	0	56	25	0
	Kishma Id. N. end	26	57	0	56	24	0
	Busheer	29	0	0	50	56	0
	Karak Fort	29	15	0	50	21	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	BUSSORAH Factory	30	30	0 N	47	33	0 E
	Churbar	25	16	0	60	24	0
	Cape Arubah	25	10	0	64	16	0
	Cape Monze	24	50	0	66	23	0
	Point Gigat	22	18	0	69	11	0
	Diu Point	20	42	0	71	5	53
	Cambay	22	20	0	72	39	0
	SURAT	21	11	0	73	2	34
	Vauxe's Tomb	21	4	30	72	48	44
	Var. 0° 30′ *W.* 1791						
	Damaun	20	22	0	73	2	45
	Omergon	20	10	30	72	56	30
	St. John's Point	20	3	0	72	49	0
	Basseen Fort	19	19	0	72	55	24
	BOMBAY	18	55	42	72	54	24
	—Light House	18	53	0	72	52	54
	Var. 1° 0′ *W.*						
	Henery&KeneryIs.	18	42	20	72	53	0
	Coullaba I.	18	37	20	72	56	30
	Chaoul	18	32	30	73	0	0
	Bancoot	17	56	40	73	7	54
	Severndroog	17	47	30	73	9	0
	Dabul	17	46	0	73	11	0
	Gheriah	16	30	41	73	22	24
	Vingorla Rocks	15	51	0	73	30	0
	GOA	15	28	20	73	53	30
	Alguado Point	15	28	55	73	48	39
	St. George's Island	15	21	0	73	48	0
Malabar Coast.	Oyster Rocks	14	48	0	74	8	0
	Carwar Head	14	47	0	74	12	30
	Onore	14	16	0	74	34	0
	Fortified Island	14	17	0	74	29	0
	Pigeon Island	14	4	0	74	27	0
	Barcelore	13	45	0	74	50	0
	St. Mary's Rocks	13	21	0	74	49	0
	Permira Rocks	13	11	0	74	52	0
	MANGALORE	12	50	30	75	12	0
	Mount Dilly	11	59	40	75	30	0
	Cananore	11	51	0	75	10	0
	Tillicherry	11	45	20	75	47	30
	Sacrafice Rock	11	30	0	75	50	0
	Calicut	11	15	0	76	6	0
	Cranganore	10	17	0	76	23	0
	Cochin.	9	57	30	76	30	0
	Quilon	8	51	30	76	48	0
	Anjango Roads	8	39	25	77	0	0
	CAPE COMORIN	8	4	0	77	45	0
	Manapar Point	8	22	0	78	16	0
	Trinchindor Pagod	8	30	0	78	13	0
Coromandel Coast.	Point Calymere	10	18	30	79	58	0
	Negapatam	10	45	30	79	55	26
	Tranquebar	11	1	30	79	54	30
	Devicotta	11	24	0	79	50	0
	Porto Nova	11	31	0	79	48	0
	Cuddalore	11	43	0	79	50	30
	PONDICHERRY	11	55	41	79	53	45
	Sadras	12	32	0	80	14	0
	MADRAS,						
	—Fort St. George.	13	4	10	80	21	35
	Var. 0° 35′ *E.* 1798						
	Pullicate	13	25	0	80	26	0

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
Coromandel Coast.	Armegon	13	59	0 N	80	22	0 E
	Point Divy	15	59	0	81	16	0
	MASULIPATAM	16	11	0	81	12	45
	Point Gordewar	16	48	0	82	24	0
	Coringa	16	49	0	82	16	0
	Visagapatam	17	42	30	83	26	0
	Bimliapatam	17	53	0	83	36	0
	Chicacole	18	18	0	84	0	0
	Ganjam	19	22	30	85	10	30
	Jagernaut Pagoda	19	48	21	85	52	0
	Black Pagoda	19	52	15	86	6	0
	False Point	20	19	0	86	46	0
	Point Palmiras	20	44	0	87	6	0
	BALASORE	21	30	0	87	1	30
	Ingerlee Pagoda	21	44	0	88	1	0
	Kedgeree	21	51	0	88	7	0
	CALCUTTA,						
	—Fort William	22	34	40	88	28	15
	Chandernagor	22	51	26	88	29	30
	Mud Point	21	56	0	88	15	0
	Sauger	21	36	0	88	11	0
	Light House Point	21	28	0	88	25	0
	Tail of E. Sea Reef	20	57	0	88	20	0
	Tail of W. Sea Reef	20	59	0	88	5	0
	W. ft. of the Brace	21	12	0	87	45	0
	Islamabad, or						
	Chittagong	22	20	0	91	49	30
Pegu.	Aracan River	20	12	0	92	42	0
	Cheduba I. N. W. pt	18	58	0	93	18	0
	Cape Negrais	16	2	0	94	13	0
	Diamond Isle	15	52	0	94	19	0
	Bragu Point	15	44	0	95	22	0
	Martaban	16	29	0	97	15	0
	PEGU	18	0	0	96	52	0
	Tavay Point	13	33	0	98	6	0
	Merguy	12	12	0	98	24	0
Malay.	Junkselon, High						
	Mount. S. end	7	45	0	98	20	0
	Slipper Island	7	20	0	98	49	0
	Queda Fort	6	6	0	100	21	0
	Pulo Pinang, or						
	Pr. of Wales I.,						
	—Fort Cornwallis	5	24	30	100	21	30
	Parcelar Hill	2	52	0	101	29	0
	MALACCA	2	12	0	102	15	0
	Mount Formosa	1	49	0	102	56	0
	Pulo Pisang	1	28	0	103	16	0
	Point Romania	1	23	30	104	16	0
	Tringano River	5	21	0	103	4	0
China.	SIAM River. ent.	13	29	40	101	15	0
	Camboja Point	8	40	0	104	55	0
	Cape St. James	10	18	0	107	10	0
	Cape Avarello	12	55	0	109	24	30
	Pulo Canton	15	23	0	109	6	0
	Turon Cape	16	5	0	108	15	0
	Tigers I.	16	54	0	107	20	0
	Tienpack, ent. to.	21	24	0	111	20	0
	Hailin Id. W. Pt.	21	34	30	111	54	15
	Mandarine's Cap.	21	28	0	112	22	20
	Hawcheun, or						
	False St. John's I.	21	35	15	112	38	0
	—South Point	21	33	40	112	50	0

LATITUDES AND LONGITUDES.

Places.	Latitude.			Longitude.		
	°	′	″	°	′	″
MACAO	22	10	30 N	113	32	0 E
Grand Ladrone ..	21	57	0	113	44	0
Linting	22	24	30	113	48	0
Grand Lema W.pt	22	2	0	114	14	30
CANTON	23	7	0	113	16	0

XVI. Islands, Rocks, and Shoals, in the INDIAN OCEAN.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Telemaque Shoal.	38	11	0 S	21	58	0 E
	Fortune Shoal ...	33	8	0	43	5	0
	Augusta Shoal ...	33	44	0	36	16	0
	Otter's Shoal	33	56	0	36	0	0
	Barker's Rock...	37	43	0	32	5	0
	Dutch Bank.....	37	20	0	38	52	0
	Pr. Edward's Isles,						
	—North end.....	46	39	30	38	2	30
	—South end	46	52	30	37	47	0
	Desert Islands ...	48	5	0	48	0	0
	Necklegal	40	40	0	54	0	0
	Kergulen's Land,						
	—Christm. Harb.	48	41	15	69	2	0
	—Cape Digby ...	49	23	30	70	32	0
	—Cape George ..	49	54	30	70	12	0
	—Port Paliser...	49	3	15	69	35	0
	St. Paul's Island .	38	44	0	77	53	0
	Amsterdam I. ...	37	52	0	77	53	0
	Cloates I.	22	8	0	112	30	0
	Tryal Rocks	19	30	0	105	30	0
	Christmas Island .	10	33	0	105	33	0
	Cocos, or						
	Keeling's Islands,						
	—Northernmost..	11	50	0	97	0	0
	True Briton's I...	9	30	0	89	14	0
	Le Meme's Reef .	1	20	0 N	94	20	0
	Cape St. Mary...	25	40	0 S	45	16	0
	ST. AUGUSTIN'S B.						
	—Sandy Island ..	23	39	0	44	0	0
	Cape St. Vincent.	21	46	0	43	50	0
	Cape St. Andrew's	16	2	0	45	16	0
Madagascar Island.	Table Cape	15	43	0	46	6	0
	Bembatooka Bay	15	43	0	46	28	0
	Majambo Bay ...	15	10	0	47	6	0
	Narreenda Bay ..	14	31	0	47	45	0
	Dalrymple's Bay.	13	31	0	48	9	0
	Passandava Bay .	13	45	0	48	23	0
	Var. 18° 45′ *W.* 1802						
	Cape St. Sebastian	12	28	0	48	54	0
	Cape St. Ambro..	12	2	0	49	24	0
	Antengil Bay, ent.	16	27	23	50	23	15
	St. Mary's Island	17	0	0	50	25	0
	Foul Point	17	41	0	49	36	0
	Point Itapare....	24	58	30	46	44	0
	Port Dauphin ...	25	1	0	46	38	0
	Star Bank, N. end	25	7	0	44	16	0
	Bassas de India..	22	28	0	40	37	0
	Europa Rocks ...	21	28	0	40	8	0
Mozambique Passage.	*Var.* 23° 50′ *W.*						
	Sussex Rocks.....	21	22	0 S	42	42	0 E
	Bazaruto Is. N. end	21	30	0	36	2	0
	English Bank.....	17	42	0	40	15	0
	Juan de Nova, or						
	St. Christopher's I.	17	2	0	43	9	0
	Barren Is.........	18	26	0	44	15	0
	Coffin Island	17	30	0	44	4	30
	Chesterfield Shoal.	16	20	0	44	8	0
Comoro Is.	Mayotta (Peak)...	12	54	0	45	14	0
	JOHANNA BAY ...	12	7	30	44	30	0
	Var. 17° 36′ *W.* 1798						
	Mohilla	12	20	0	43	50	0
	Comoro	11	32	0	43	25	0
	John Martin's I. ..	10	19	0	43	30	0
	Portuguese Shoals.	12	30	0	46	47	0
	Firebrass Bank ...	13	16	0	46	20	0
	Aldabra Islands...	9	17	0	46	14	0
	Assumption.......	9	50	0	47	16	0
	Cosmoledo Islands	9	45	0	48	40	0
	Natal Island......	8	26	0	47	12	0
	St. Peter's Island..	9	22	0	51	45	0
	Juan de Nova	10	15	0	52	20	0
	Astove Islands....	10	20	0	53	32	0
	St. Lawrence Is...	9	35	0	52	15	0
	Providence Island.	9	10	0	53	7	0
	Inverarity, or						
	Alphonsina I......	7	3	30	52	49	0
	Zanzibar I........	6	6	0	40	15	0
	Amirante Is., S. Pt.	6	20	0	54	40	0
	—Eagle I.	5	11	0	54	4	0
	Mahé Bank,						
	—N. W. part	3	20	0	54	40	0
	—S. E. part	5	25	0	57	0	0
	Curreuse I........	4	10	0	55	45	0
	African Islands ...	4	55	0	54	9	30
	Seychelle, or Mahé	4	35	0	55	35	0
	Var. 7° 44′ *W.* 1801						
	Praslin Island	4	19	0	55	47	0
	Fortune Bank	7	7	0	57	4	0
	Coitive I.	7	14	0	56	32	0
	Sandy Island	15	52	0	54	50	0
	Cardagas Bank,						
	—North part	13	30	0	60	30	0
	—South part	16	45	30	59	59	20
	Gallegos Shoal....	10	25	0	56	45	0
	St. Brandon Shoals	16	38	0	62	50	0
	Roderigos.........	19	40	38	63	11	30
	Var. 13° *W.* 1802.						
	Mauritius, or						
	Isle of France,						
	—Port Louis, or						
	Port North West	20	9	45	57	29	15
	Var. 16° 20′ *W.* 1789						
	L'Isle de la						
	Reunion, or						
	Bourbon,						
	—St. Dennis	20	51	43	55	30	0
	South Roquepiz. .	10	30	0	64	30	0
	Speaker's Bank . .	4	48	0	72	30	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	ChagosArchipelago						
	—Peros Banhos...	5	22	0 S	71	53	0 E
	—Boddam's I. ...	5	22	0	72	15	0
	—Eagle Is...	6	10	0	71	21	0
	—Diego Garcia...	7	20	0	72	28	0
	Centurion Rocks..	7	41	10	70	59	0
	Centurion Shoal ..	7	41	0	72	52	0
	Candu Islands	5	53	0	76	45	0
	Adu Islands	5	15	0	76	25	0
	Gama Island	2	10	0	76	10	0
	Grenville's Rock ..	0	10	0	80	52	0
	Pulo Oura	0	40	0	82	6	0
	Bale of Cotton Rk.	5	18	0 N	88	20	0
	Maldive Is. S.E. pt.	0	36	0 S	73	25	0
	—N. W. part	7	6	0 N	73	8	0
	Malique..........	8	16	30	73	13	0
	Laccadive Isles,						
	—Seuvelli Is......	10	0	0	72	36	0
	—Kalpeny I.	10	4	0	73	48	0
	—Underoot	10	48	0	74	0	0
	—Elicalpeni Bank	11	15	0	74	20	0
	—Courutee I.	10	34	0	73	0	0
	—Pittu	10	48	0	72	51	0
	—Ameni	11	6	30	73	8	0
	—Cardamun......	11	14	0	73	12	30
	—Kittan	11	29	0	73	24	0
	—Chittae	11	42	0	73	4	0
	—Aucutta........	10	51	30	72	31	0
	—Peremulpar	11	9	0	72	28	30
	—Betra-par	11	35	30	72	34	0
	—Cherbaniani Bk.	12	22	0	72	10	0
	—North West pt. .	13	30	0	70	45	0
	Angrias Bank, mid.	16	30	0	71	55	0
	Elizabeth Bank ...	17	5	0	71	28	0
	——						
Ceylon Island.	Point Pedro......	9	49	30	80	24	0
	COLOMBO	6	57	0	80	0	0
	Point de Galle....	6	4	0	80	19	20
	Dondra Head	5	55	30	80	42	20
	Grand Bassas.....	6	13	0	81	46	0
	Little Bassas	6	24	30	81	55	0
	Elephant Point ...	6	20	0	81	39	15
	Battacolo Roads ..	7	44	0	81	52	0
	Venloos Bay	7	57	0	81	44	0
	TRINCOMALEY ...	8	33	30	81	20	50
	Var. 0° 30′ *E.* 1798						
	——						
	Preparis Island ...	14	52	0	93	41	0
	Preparis Reef	14	45	0	93	39	0
	Great Coco I.,						
	—North end......	14	8	0	93	26	30
	Little Coco I.	13	58	30	93	18	0
	——						
Andaman Islands.	Great Andaman,						
	—North end......	13	34	0	93	9	0
	—South end	11	26	0	92	54	0
	—Port Cornwallis.	13	18	0	93	10	0
	Little Andaman,						
	—South end	10	26	0	92	43	0
	The Brothers	10	55	0	92	48	0
	——						
	Barren Island	12	17	0	93	54	0

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Narcondam I. ...	13	24	0 N	94	12	0 E
	Invisible Shoal ..	11	8	0	93	38	0
	——						
Nicobar Islands.	Car Nicobar.....	9	10	0	92	56	0
	Batty Malve I. ..	8	46	30	92	57	0
	Telingchon, N. end	8	32	0	93	43	0
	Noncowry I.	8	0	0	93	41	0
	Sombrero Channel	7	45	0	93	35	0
	Miroe Island	7	29	0	93	46	0
	Little Nicobar,						
	—N. end........	7	27	0	93	53	0
	Great Nicobar,						
	—S. end	6	45	0	94	0	0
	——						
	TanasserimI. N.pt	12	38	0	97	32	0
	Tores Is.........	11	50	0	97	1	0
	Domel I. N. end .	11	23	0	97	50	0
	Seyer Is.........	8	36	0	97	46	0

XVII. Islands, Rocks, and Shoals, between the INDIAN and PACIFIC OCEANS, from Sumatra to New Guinea.

	Places.	Latitude.			Longitude.		
	Diamond Point ..	5	18	0 N	97	48	0 E
	Tanjong Bon	1	6	0 S	104	20	0
	Lucepara Point..	3	14	0	106	0	0
	Hog's Point	5	54	0	105	42	0
	Flat Point.......	6	0	0	104	40	0
	Pulo Pisang.....	5	10	0	103	53	0
	BENCOOLEN	3	48	0	102	28	0
Sumatra.	*Var.* 1° 10′ *E.*						
	Indrapour Point .	2	12	0	100	40	0
	Padang	0	56	0	100	3	0
	Priaman	0	41	0	99	52	0
	Natal	0	29	0 N	98	58	0
	Tapanooly Bay ..	1	40	0	98	54	0
	Barroos	1	56	0	98	33	0
	Point Labon.....	3	6	0	96	48	0
	Cape Felix	3	47	0	95	58	0
	ACHEEN Head,						
	—King's Point...	5	33	0	95	17	0
	—Point Pedro ...	5	42	0	95	35	0
	——						
Islands near the W. Coast of Sumatra.	Pulo Way, E. Pt.	5	46	0	95	27	0
	—West end	5	48	0	95	18	0
	Pulo Rondo, mid.	6	4	30	95	14	0
	PuloBrasse, E.Pt.	5	42	0	95	13	0
	—North end.....	5	46	0	95	6	0
	PuloNancy, E.Pt.	5	40	0	95	17	0
	Cocos Island	3	6	0	95	12	0
	Hog Island, N. Pt.	2	50	0	95	30	0
	PuloBanjack, S.P.	2	5	0	96	48	0
	Pulo Nias, S. Pt..	0	32	0	97	9	0
	Claps Id.	0	5	0	97	36	0
	Pulo Batoa, N. Pt.	0	10	0	98	45	0
	PuloMinton, S.Pt.	0	40	0 S	98	10	0
	Se Booro, N. Pt..	0	56	0	98	38	0
	—S. E. Point....	1	47	0	99	14	0
	Se Pora,						
	—N. W. Point...	1	54	0	99	26	0
	—Pt.Marlborough	2	25	0	99	58	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	NorthPoggy, N.pt	2	32	0 S	100	0	0 E
	SouthPoggy, S.pt.	3	20	0	100	35	0
	Trieste Island	4	2	0	101	22	0
	Enganno I. S. pt.	5	27	0	102	33	0
	—						
Str. of Malacca and Sincapore.	Pulo Bouton	6	33	0 N	99	20	30
	Pulo Pera	5	42	0	99	1	0
	Pulo Pinang, or Pr. of Wales Id.	5	24	30	100	21	30
	Pulo Dinding	4	16	0	100	38	0
	Pulo Jarra	4	0	0	100	14	0
	Pulo Varela	3	47	0	99	36	30
	Brothers, —Northernmost	3	24	0	99	54	0
	LongArroe, N.end	2	54	0	100	43	0
	Round Arroe	2	49	30	100	50	0
	Little Carrimon	1	9	30	103	25	0
	Tree Island	1	7	30	103	40	0
Ent. to China Sea.	Barn Island	1	13	0	103	42	0
	Black Rock	1	12	0	103	48	0
	St. John's, S. Point	1	17	0	103	50	0
	Bintang, Hill	1	2	30	104	30	0
	Pedro Blanca	1	20	30	104	25	30
	Pulo Panjang	1	4	0	104	54	0
	Pulo Tingy	2	16	0	104	7	0
	Pulo Auro	2	29	30	104	34	30
	PuloTimon, N.Pt.	2	54	0	104	15	0
	Pulo Varelle	3	16	0	103	46	0
	—						
Anambas Is.	North Anambas	3	27	0	100	15	0
	Gt. Anambas, W.pt	3	2	0	105	46	0
	Pulo Domar	2	45	0	105	27	0
	South Anambas	2	18	0	106	13	0
	Saddle Island	2	25	0	105	45	0
	—						
	The White Rock.	2	15	0	105	36	45
	North Natunas	4	50	0	108	4	0
	Gt. Natuna, S. end	3	40	0	108	19	0
Entrance to the China Sea.	S. Natunas, West I.	2	42	0	108	40	0
	St. Pierre	2	0	0	108	54	0
	Victory's Island	1	34	0	106	23	0
	Saddle Island	1	17	0	107	4	0
	Camel's Hump	1	10	0	106	57	0
	St. Julian's Island	0	54	0	106	47	0
	Timbelan's Is.	1	0	0	107	36	0
	St. Esprit Is. E. end	0	35	0	107	12	0
	St. Barbe	0	9	0	107	[illegible]	0
	Direction Island	0	15	30	108	[illegible]	0
	Porto Bello	0	54	0 S	106	40	0
	CaremataI. NW. pt	1	33	0	108	49	0
	SouroutouI., W.P.	1	42	0	108	42	0
	Wellesley's Shoal	1	19	0	108	35	0
	Ontario's Reef	2	3	0	108	40	0
	Montaran Is.	2	33	0	108	36	0
	Billiton, N.W. Pt.	2	36	0	107	35	0
	—South East Pt.	3	24	0	108	12	0
	—South West Pt.	3	15	0	107	30	0
	Shoal Water Id.	3	20	30	107	13	0
	Vansittart's Shoal	2	11	15	106	46	0
	Warren Hasting's Shoal	2	21	30	106	57	0
	Gaspar Island	2	25	35	107	5	15

	Places.	Latitude			Longitude.		
		°	′	″	°	′	″
	Tree Rock	2	27	30 S	106	59	0 E
	MiddleI. S.W. Pt.	2	55	0	107	3	45
	Alceste Rock	2	46	0	107	2	0
	—						
Banca I.	Munzooda Pt.	1	27	0	105	51	0
	Tanjong Goonting	1	43	0	105	22	0
	Mount Monopin	2	0	0	105	14	0
	Mount Permisan	2	36	30	105	55	0
	Lalary Point	2	47	30	105	54	0
	Entrance Pt.	3	2	0	106	54	0
	—						
	Luccpara Island	3	12	30	106	12	0
	Pulo Toty	0	58	0	105	42	0
	The Seven Islands	1	5	16	105	24	4
	Lingen Id., E. Pt.	0	21	0	105	4	0
	Dogger's Bank	0	39	0 N	105	24	0
	—						
	Princes' Id. Peak	6	35	0 S	105	19	0
	Cracatoa, Peak	6	8	0	105	28	30
	—						
Strait of Sunda.	Pulo Besse, or Tamarind Island.	5	57	0	105	31	0
	PuloRacket S.Pt.	5	53	0	105	32	0
	Thwart the Way	5	56	30	105	51	0
	North Island	5	41	0	105	50	13
	Three Sisters	5	43	30	105	49	0
	The Button	5	53	30	105	58	0
	The Cap	6	0	30	105	56	0
	PuloBabee, E.end	5	47	0	106	19	0
	South Watcher	5	41	45	106	42	45
	North Watcher	5	12	30	106	32	0
	Two Brothers, or Two Sisters	5	9	30	106	5	0
	Jason's Rock	5	30	0	106	20	0
Java Sea.	Pulo Racket	5	58	0	108	33	0
	Fox's Reef	3	31	0	110	5	0
	Carimon Java	5	50	0	110	34	0
	Lubec Island	5	45	0	112	48	0
	Arrogants Rocks.	5	12	0	113	0	0
	Great Salombo	5	33	0	114	28	0
	Little Salombo	5	24	0	114	28	0
	Arentes	5	10	0	114	36	0
	—						
Java Island.	Java Head	6	48	0	105	17	0
	Var. 1° 30′ *E.* 1790						
	Anjer Point	6	4	0	105	54	30
	St. Nicholas Point	5	54	0	106	2	0
	Bantam Point	5	52	0	106	6	0
	Bantam	6	4	0	106	12	0
	BATAVIA, obs.	6	9	0	106	51	45
	Edam Island	5	57	0	106	53	30
	Indermay Point	6	10	0	108	30	0
	Cape Sandana	7	39	0	114	36	0
	East Point	8	39	0	114	40	0
	Wesels Bay	8	10	0	112	55	0
	Turtle Bay	7	45	0	109	47	0
	Wine Coopers' Pt.	7	24	0	106	30	0
	—						
	MaduraI. NW. Pt.	6	53	0	112	45	3
	—East Point	6	53	0	113	58	30
	Bally I. S. Point	8	57	0	115	9	0
	Bally Str. S. ent.	8	45	0	114	40	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Banditti I. S.E. Pt.	8	46	0 S	115	31	0 E
	Lombock I. S. Pt.	8	47	0	116	2	0
	—Peak	8	21	30	116	26	0
	Lombock Strait,						
Eastern Straits to China.	—S. entrance	8	45	0	115	36	0
	Var. 1° 30′ *W.*						
	Allas Str. S. entr.	8	50	0	116	28	0
	Sumbawa I. W. pt.	9	5	0	116	38	0
	—S. East end	8	42	0	119	14	0
	Gunongapee, Pk.	8	11	0	119	5	0
	Strait of Sapy	8	50	0	119	35	0
	Bangalore Shoal .	7	40	0	121	15	0
	Str. of Mangeray .	8	35	0	120	9	0
	Strait of Flores ..	8	40	0	123	3	0
	Solor Straits	8	18	0	123	6	0
	Ombay I. E. Pt. .	8	17	0	125	15	0
	Sandlewood Id.,						
	—West Cape	9	42	0	119	0	0
	—East Cape	10	0	0	120	35	0
	Savu I., Factory .	10	37	0	122	0	0
	New I. near Savu	10	40	0	121	3	0
	Rotto Id. SW. end	11	2	0	122	55	0
	Savul Shoal, W. en.	11	33	0	124	10	0
	Shoal	12	45	0	124	28	0
	Coral Shoal	13	25	0	124	10	0
	Shoal	13	32	0	124	29	0
	Red Island	15	10	0	124	20	0
	Semao Id. S. end.	10	25	0	123	12	0
	Strait of Samoa,						
	—West entrance .	10	33	0	123	20	0
	Timor I. S. W. Pt.	10	23	0	123	30	0
	—N. E. Point ...	8	21	0	127	15	0
	Pulo Bato	9	16	0	124	0	0
	Timorlaut, S. Pt. .	8	15	0	131	50	0
	Arroe Is. S. end . .	7	6	0	135	0	0
Banda Sea.	Banda Island	4	31	0	130	0	0
	Burning Island ..	6	35	0	126	40	0
	Booro I., Town ..	3	25	0	127	0	0
	—N. W. end	3	6	0	125	57	0
	—South end	3	54	0	126	33	0
	AMBOYNA,						
	—Fort Victoria ..	3	40	0	128	15	0
	Great Xulla, S. end	1	51	0	124	52	0
	Xulla Mangola,						
	—West end	1	43	0	125	21	0
	Xulla Bessee,						
	—N. W. end	1	58	0	125	48	0
	Little Salwatty ..	3	57	0	131	17	0
	Ceram Laut	3	53	0	130	59	0
	———						
	Lahoe, W. end ..	3	18	0	128	0	0
Ceram I.	Amahoy	3	21	0	128	58	0
	Kessing, E. Pt. ..	3	55	0	130	40	0
	Razaket Pt E. end	3	36	0	130	51	0
	Waroo Bay	3	25	0	130	30	0
	Saway Bay	2	51	0	129	0	0
	———						
	Harakau	3	37	0	128	29	0
	Separau	3	36	0	128	43	0
	Manipa	3	17	0	127	28	0
	Kelar	3	16	0	127	33	0
	Bonoa	2	57	0	127	54	0

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Oby Major, W. Pt.	1	30	0 S	127	15	0 E
Pitt's Passage.	Gomona	1	56	0	127	38	0
	Pulo Pisang	1	23	0	128	53	0
	Mysole, West Pt.	1	54	0	129	30	0
	Kanary	1	44	0	129	14	0
	Pulo Popa, S. end	1	12	0	129	52	0
	Salwatty, Pt. Pigon	0	58	0	130	34	0
	—North East Pt.	0	54	0	130	56	0
	Battenta, C. Mebo	0	56	0	130	25	0
	—East end	0	47	0	131	10	0
	Pigeon Island ...	0	37	0	130	38	0
	Foul I.	0	40	0	130	40	0
	Wesogee I. SW. Pt.	0	28	0	130	23	0
	—Point Pigot ...	0	21	0	131	18	0
	Geby Id., Harbor.	0	4	0	129	20	0
	Youl Is.	0	28	0	131	0	0
	Asia's Is.	1	0	0	131	20	0
	Gillolo I., N. end.	2	23	0 N	128	15	0
	—South end	0	45	0 S	128	22	0
Moluccas.	Moratay, N. Cape	2	44	0 N	128	25	0
	—South end	1	45	0	128	16	0
	Ternate Island ...	0	50	0	127	32	0
	Tidore Island	0	43	0	127	37	0
	Tyfore I.	0	58	0	126	27	0
	Myo Island	1	12	0	126	39	0
	Salibobo Islands,						
	—Southernmost ..	3	47	0	126	45	0
	Glatton's Rock ..	3	50	30	125	35	0
	Haycock	2	56	0	125	50	0
	Sanguy I. N. end.	3	46	10	125	17	10
	Siao Island, Peak	2	43	0	125	24	15
	Bijarre I. Peak ..	2	15	0	125	10	0
	Tagalonda	2	25	0	125	20	0
	———						
	Banka I.	1	52	0	125	0	0
	Monado Fort	1	27	0	124	38	0
	Cape Coffin	1	42	0	125	0	0
	Strait of Limba ..	1	22	30	125	14	0
	Castican Bay	0	48	0	124	45	0
	Goonongtalla R. .	0	30	0	123	0	0
	Cape Talabo	0	48	0 S	123	57	0
Celebes.	Cape Lessen	4	54	0	121	28	0
	Cambynas I. Peak	5	16	0	122	9	0
	Bontheam	5	34	0	120	32	0
	MACASSAR	5	9	0	119	38	45
	Mandhar Point ..	3	35	0	119	9	0
	Cape William	2	34	0	118	58	0
	C. Timoel, NW. pt.	0	1	0 N	119	26	0
	Donda Point	0	48	0	119	57	0
	Cape Rivers	1	15	0	120	34	0
	———						
	Bouton I., N. pt.	4	21	0 S	123	5	0
Straits of Macassar.	—Southpoint	5	48	0	122	44	0
	N. Token Bessee.	5	10	0	123	40	0
	Salayer I., N. pt. .	5	48	0	120	46	0
	Brill Shoal	6	5	0	119	0	0
	Postilions, N.W. pt.	6	32	0	118	48	0
	Rotterdam Island	5	13	0	117	39	0
	Waller's Shoals ..	4	37	0	117	8	0
	Little Pulo Laut Is.						
	—South end	4	48	0	116	0	0
	Moresses	4	25	0	116	3	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
S.r. of Macassar.	Brothers	4	26	0 S	116	32	0 E
	Divaider	4	12	0	116	21	0
	Great Pulo Laut,						
	—South Point ...	4	6	0	116	14	0
	—N. E. Point ...	3	23	0	116	41	0
	The Three Alike.	3	41	0	116	54	0
	South Watcher ..	0	8	0 N	119	26	0
	North Watcher ..	0	35	0	119	37	0
	——						
Borneo Island.	North Point	7	0	0	116	50	0
	Unasang Point...	5	17	0	119	25	0
	Kaneoogan Point	1	5	0	119	10	0
	Ragged Point ...	2	10	0 S	116	48	0
	Shoal Point	2	35	0	116	47	0
	Point Salatan....	4	10	0	114	42	0
	Flat Point	3	30	0	111	50	0
	Point Sambar ...	2	51	0	109	45	0
	Tanjong Factie ..	1	6	0	109	23	0
	Sambas Roads...	1	12	0 N	109	15	0
	Tanjong Apee ...	2	19	0	109	25	0
	Tanjong Dato ...	3	0	0	110	13	0
	BORNEO	4	55	0	114	55	0
	——						
	Banguey Peak...	7	19	0	117	6	30
	Balambangan I.,						
	—North point ...	7	16	0	116	58	0
	Balabec.........	7	57	0	116	56	0
	Palawan, S. point	8	10	0	117	3	0
	—North point ...	11	31	0	119	25	0
	Cagayan Sooloo..	7	0	0	118	36	0
	Sooloo I.,						
	—Temontanges ..	5	57	0	120	53	30
	—Tulyan	6	1	0	121	12	0
	Basilan Id. E. pt.	6	30	0	122	30	0
	——						
	Mindanao,						
	—Samboangan...	6	54	0	122	2	0
	—Port St. Maria.	7	33	0	122	0	0
	—Banajao Point.	9	40	0	125	20	0
	—C. St. Augustine	6	13	0	125	58	0
	—MINDANAO ...	7	10	0	124	30	0
	Samar,						
	—St Espiritu Santo	12	35	0	125	17	0
	St. Bernardino, I.	12	46	0	124	15	0
Philippine Islands.	Mindoro,						
	—Calavite Point	13	27	0	120	20	0
	—South Point ..	12	11	0	121	14	0
	Goat Island	13	52	0	120	6	0
	Mirabello Shoal..	14	40	0	119	30	0
	Marsingola Shoal	15	13	0	117	46	0
	Luconia,						
	—Albay Volcano.	13	44	15	123	34	58
	—MANILLA	14	36	8	120	51	30
	—Subic.........	15	5	0	120	0	0
	—Capones Point.	14	52	30	120	3	30
	—Boliano Point .	16	27	30	120	0	0
	—Cape Bajador .	18	42	0	120	52	15
	—Cape Enganno.	18	37	0	122	10	0
	—C. St. Ildefonso	15	25	5	121	46	30
	Mauban...... ..	14	8	0	121	44	0
	Manbulao	14	18	0	122	43	0

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Camiguen Island,						
	—Volcano......	18	54	0 N	121	43	10 E
	——						
	Bashee Is. N.most	21	8	30	122	9	0
	Bottel Tobago						
	Xima	21	59	0	121	48	0
	Vele Rete Rock .	21	42	0	121	3	30
	Formosa I. SE. end	21	54	0	121	5	0
	—Tayoan	22	35	0	120	32	0
	—North East End	25	11	0	121	56	0

XVIII. Islands, Rocks, and Shoals, in the CHINA SEA.

	Places.	Latitude.			Longitude.		
	Pulo Panjang....	1	4	0 N	104	52	0 E
	Pulo Tingy......	2	18	0	104	9	0
	Pulo Auro	2	29	30	104	33	30
	Pulo Timon,						
	—North pt.	2	54	0	104	15	0
	Pulo Varelle	3	16	0	103	46	0
	——						
Anambas Is.	North Anambas..	3	27	0	106	15	0
	Great Anambas..	3	2	0	105	46	0
	Pulo Domar.....	2	45	0	105	27	0
	South Anambas ..	2	19	0	106	13	0
	Saddle Island....	2	25	0	105	45	0
	——						
	The White Rock.	2	15	0	105	36	45
	North Natunas ..	4	50	0	108	4	0
	Great Natuna,						
	—South end.....	3	40	0	108	19	0
	South Natunas,						
	—West I........	2	42	0	108	40	0
	St. Pierre	2	0	0	108	54	0
	Saddle Island....	1	17	0	107	4	0
	Victory's Island..	1	34	0	106	23	0
	Camel's Hump ...	1	10	0	106	57	0
	St. Julian's Island	0	54	0	106	47	0
	Timbelan's Is. ...	1	0	0	107	36	0
	St. Esprit Islands,						
	—E. end........	0	35	0	107	12	0
	St. Barbe	0	9	0	107	16	0
	Direction Island .	0	15	30	108	10	0
	Pulo Brala	4	47	0	103	37	0
	Great Ridang....	5	53	0	102	55	0
	Pulo Coron......	9	57	0	100	10	0
	Pulo Way.......	9	55	0	103	45	0
	Pulo Ouby	8	25	0	104	54	0
	Two Brothers ...	8	30	0	106	14	0
	Pulo Condore ...	8	40	48	106	42	54
	Pulo Sapata	10	1	0	109	2	30
	Po. Cecir do Mar	10	32	30	108	53	0
	De Breto's Reef..	10	32	0	107	55	0
	Holland's Bank ..	10	42	0	108	40	0
	Po. Cecir da Terra	11	13	0	108	48	0
	Luconia's Shoals,						
	—Hard Rocks...	5	21	0	112	38	0
	—Two fath. Shoal	5	5	0	112	24	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	—Dry Sand......	4	57	0 N	112	30	0 E
	Sea Horse's Reef.	5	35	0	112	28	0
	Euphrates' Shoals	5	38	0	113	24	0
	Kirton's Shoal ...	5	39	0	113	15	0
	Marino's Shoals..	5	54	0	114	18	0
	Louisa's Breakers	6	21	0	113	18	0
	Barton's Shoal ...	6	55	0	116	15	0
	R.Charlotte'sRks.	6	56	0	113	34	0
	Vipers Bank.....	7	30	0	115	7	0
	Walpole's Rocks .	7	50	0	114	30	0
	Vipers Breakers .	8	0	0	115	25	0
	Pr. of Wales'Bank	8	9	0	110	30	0
	Sea Horse's Break	8	47	0	116	44	0
	Royal Captain Sh.	9	4	30	116	41	0
	Gossard's Reef...	8	58	0	110	40	0
	Ganges Breakers.	9	22	0	114	12	0
	Marino's Rocks .	9	39	0	114	58	0
	Investigator S. Sh.	8	8	0	114	40	0
	———N. E. Shoal	9	6	0	116	30	0
	———N.W.Shoal	9	42	0	113	6	0
	WestLondonShoal	8	54	0	112	0	0
	EastLondon Shoal	8	51	0	112	25	0
	Western Reef....	10	15	0	113	41	0
	South Island.....	10	45	0	114	27	0
China Sea.	N. W. Island	11	9	0	114	18	0
	North Danger....	11	26	0	114	22	0
	Bombay's Shoal ..	9	26	0	116	55	0
	Marino's Bank...	10	18	0	115	7	0
	R. Charlotte's Sds.	10	47	0	114	29	0
	Marino's White S.	10	48	0	115	13	0
	——Low Black I.	11	1	0	115	17	0
	Sea Horse's Bank	10	52	0	117	53	0
	Falmouth's Low I.	10	58	0	112	12	0
	————Bank .	11	25	0	114	15	0
	SabutJungs Low I.	11	32	0	113	29	0
	————Bank .	11	34	0	113	51	0
	Gasper Shoals ...	11	36	0	113	51	0
	Mirabello Shoal ..	14	40	0	119	30	0
	Marsingola Shoal.	15	13	0	119	16	0
	Boliano Shoal....	16	28	30	119	42	10
	Scarboro' Shoal,						
	—N. E. end	15	13	40	117	47	0
	—S. W. end	15	4	0	117	47	0
	MacclesfieldShoal						
	—N. E. side.....	16	2	0	114	42	0
	—S. W. side	15	28	0	114	36	0
	St. Esprit's Bank.	19	13	0	112	52	0
	Pedra Branca....	22	19	30	115	8	57
	Pratas, N. E. side	20	51	0	116	50	0
	—S. W. side.....	20	38	0	116	40	0
	——						
Dangers on the Paracels.	NorthShoal,W end	17	4	30	111	27	0
	—E. end	17	6	10	111	32	38
	Amphitrite,W. end	16	59	0	112	12	0
	—E. end	16	54	0	112	23	0
	Woody Island....	16	50	0	112	19	0
	Rocky Island	16	52	0	112	20	0
	Junk's Bank.....	16	55	0	112	19	45
	Lincoln Island ...	16	40	36	112	42	0
	Pyramid Rock ...	16	35	15	112	37	30
	Money's Island ..	16	28	0	111	29	30
	Robert's Island ..	16	31	50	111	34	30

Places.	Latitude.			Longitude.		
	°	′	″	°	′	″
Pattle's Island ...	16	33	20	111	36	0
Observation Bank	16	36	0	111	41	0
Drummond's I....	16	29	10	111	43	37
Gov. Duncan's I. .	16	28	40	111	41	0
Discovery Shoal,						
—West end......	16	11	0	111	32	30
—East end	16	16	0	111	46	30
Vuladore's Shoal,						
—West end......	16	17	30	111	58	30
—East end	16	19	30	112	4	45
Passoo Keah's I. .	16	2	0	111	45	0
Triton's Bank....	15	46	38	111	11	30
Bombay's Shoal..	16	0	0	112	26	0
——						
Hainan Island,						
—North part.....	20	2	0	110	45	0
—South part.....	18	12	0	109	10	0

XIX. The Coast, and adjacent Islands, from CANTON to CAPE NORTH.

	Places.	Latitude.			Longitude.		
	CANTON	23	7	0 N	113	16	0 E
	MACAO	22	10	30	113	32	0
	Grand Ladrone ..	21	57	0	113	44	0
	Grand LemaW. pt.	22	2	0	114	14	30
	Pedra Branca....	22	19	30	115	8	57
Coast of China.	Tohaotcheou.....	23	35	0	116	26	0
	Sinentcheou	24	56	0	118	40	0
	Ouentcheoufou...	28	5	0	120	35	0
	Cape Montague ..	29	14	0	121	45	0
	Chusan Entrance .	29	42	0	121	54	0
	Ningpo..........	30	13	0	121	6	0
	Yang-tse-kiang-ho	32	5	0	120	37	0
	NANKIN.........	32	4	40	118	47	4
	Ent. to Yellow R.	34	3	0	120	0	0
	Hoingan Foo.....	33	34	40	118	49	30
	Stauntons Island .	36	47	0	122	13	0
	Cape Gower.....	36	57	0	122	19	0
China.	Har. of Ki san-sou	37	38	0	121	23	0
	Tontchoo-foo (Str. of Miatau).....	37	50	0	120	36	0
	Sa lou-poo-tien ..	38	55	0	118	43	0
	PEKIN	39	54	13	116	27	30
	C. Clonard	36	5	0	130	0	0
	Sanpou..........	37	44	0	129	13	0
Tartary.	Kinghing........	42	10	0	131	24	0
	Ternai Bay	45	13	0	137	29	0
	Suffren Bay	47	51	0	139	45	0
	C. Lesseps.......	49	30	0	141	30	0
	Castries Bay.....	51	29	0	141	59	0
	Vanjuas Point ...	52	7	0	142	42	0
	Ochotsk.........	59	20	10	143	12	30
	Yamsk	60	46	0	154	30	0
Russia.	Bolcheretsk	52	54	30	156	56	40
	C. Lopatka	51	0	0	156	42	30
	St.Peter&St.Paul	53	0	37	158	44	30
	Nisjui Kamtchatska	56	16	0	162	0	0
	East Cape	66	5	30	169	44	0
	Cape North......	68	56	0	179	11	30
	——						
	FormosaI.SE. end	21	54	0	121	5	0

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	—Tayoan	22	35	0 N	120	32	0 E
	—North East end	25	11	0	121	56	0
	Vele Rete Rock .	21	42	0	121	3	30
	Bottel Tobago Xima	21	59	0	121	48	0
	Kumi Island.....	24	25	0	123	5	0
	Hoapinsu Island .	25	44	0	123	32	0
	Tiaou su Island ..	25	55	0	123	47	0
	Taypingshau,						
	—N. E. end	24	30	0	125	6	0
	Parshongshan,						
	—S. W. end	23	41	0	124	9	0
	Lekeyo I., N. end	27	52	0	128	45	0
	—Napakian Hr. .	26	0	0	128	37	0
	Quelpert I. S. Pt.	33	14	0	126	35	0
	Tsus I. (Straits of Corea)........	34	24	0	130	0	0
	Dagelet Island ..	37	25	0	131	22	0
Islands of Japan.	Pinacles Islands .	29	43	0	132	5	0
	Tanaosima, S. end	30	10	0	132	24	0
	Gotto Is., S. end .	32	22	0	130	10	0
	Asses Ears	32	8	0	129	46	0
	Kuisin I., S. end .	31	48	0	132	35	0
	—Kokura	33	48	0	132	18	0
	—Nangasaki	32	48	0	130	12	0
	Niphon I. S.W. end	34	24	0	132	10	0
	—C. Noto	37	36	0	137	54	0
	—Jootsi sima	37	51	0	137	40	0
	—C. Sangaar	40	30	0	140	46	0
	—C. Nambu.....	39	50	0	142	30	0
	—Table Island ..	38	34	0	142	0	0
	— C. Kennis	37	10	0	141	30	0
	—White Point...	35	21	0	140	46	0
	—JEDO	36	29	0	140	0	0
	Fatsisio Island...	33	13	0	140	12	0
	Jesso I., C. Euroen	42	2	0	143	18	0
	—Mariaberg (Can. du Pic)..	44	49	0	146	40	0
	—Pic de Langle (Perouse Str.) .	45	20	0	142	2	0
I. Tchoka, or Suchalin.	C. Crillon	45	54	0	142	55	0
	Monneron Island.	46	20	0	142	5	0
	B. de Langle	47	48	36	142	17	54
	B. d'Estaing.....	48	59	38	142	20	42
	Mongee Peak ...	49	20	0	143	14	0
	Martiniere Peak .	50	12	0	143	20	0
	Boutin Point	51	1	0	142	48	0
	Ere Kagean,						
	--North East Pt.	54	13	0	146	56	0
	C. Patience	48	21	0	147	0	0
	C. Aniwa	46	0	0	144	22	0
	Staten I., S.W end	44	26	0	147	28	0
	—C. Vries (Vries Straits)	45	26	0	149	43	0
	Company's I.,						
	—Cape Schouten	46	18	0	150	58	0
	—North end.....	46	28	0	151	20	0

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Kurule Islands,						
	—Marekan, N. end	47	10	0 N	153	6	0 E
	—S. end (Bousole Straits)	46	46	0	152	32	0
	Shoom Island....	50	48	0	156	37	0
	Beering's Island .	55	36	0	167	46	0
	Clerk's Island ...	63	15	0	169	40	0
	St. Lawrence's I.	63	47	0	171	45	0
	Anderson's Island	63	4	0	167	38	0

XX. The Coast of NEW HOLLAND, and adjacent Islands.

	Places.	Latitude.			Longitude.		
Van Diemen's Land.	South West Cape.	43	32	0 S	146	6	0 E
	Mew Stone......	43	41	15	146	28	30
	South Cape......	43	37	30	146	49	0
	Pedra Blanca....	43	50	30	147	7	0
	Tasman's Head ..	43	31	0	147	27	0
	Frederick Henry Bay	42	58	0	147	46	0
	Cape Pillar......	43	11	40	148	6	0
	Oyster Bay	42	42	0	148	0	0
	Var. 6° 48′ *E.*						
	St. Patrick's Head	41	42	30	148	24	0
	Largest Swan I. .	40	43	0	148	8	0
	Cape Portland ...	40	44	0	147	56	0
	Port Dalrymple .	41	3	30	146	47	30
	Hunter's Isles....	40	24	0	144	41	0
	King's I. North pt.	39	35	30	143	53	0
	Entr. to Banks' Straits	40	38	0	148	20	0
	Furneaux Islands,						
	—Southernmost..	40	34	0	148	10	0
	—Northernmost .	39	36	0	148	10	0
	Kent's Group	39	27	0	147	15	0
	Entr Bass's Strait	39	10	0	148	10	0
New South Wales.	C. Albany Otway	38	51	0	143	29	0
	Western Port. entr	38	30	0	145	8	0
	Wilson's Promon.	39	11	30	146	21	0
	Ram Head	37	38	0	149	41	30
	Cape Howe	37	30	15	150	5	0
	Cape Dromedary	36	21	0	150	11	0
	Botany Bay,......	34	0	30	151	14	0
	Port Jackson	33	51	30	151	16	30
	Broken Bay. entr.	33	34	0	151	18	0
	Port Stephens ...	32	47	0	152	10	0
	Cape Hawke	32	13	30	152	33	0
	Smoaky Cape ...	30	55	0	153	4	0
	Cape Byron	28	37	30	153	38	30
	Point Danger ...	28	7	0	153	32	0
	Cape Morton	27	0	30	153	26	20
	Sandy Cape.......	24	42	0	153	16	20
	Cape Capricorn..	23	28	0	151	15	0
	Keppel Bay	23	29	30	150	58	0
	Cape Townsend..	22	13	30	150	29	0
	Cape Palmerston.	21	27	30	140	28	0
	Cape Hillsborough	20	57	0	149	2	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Cape Couway....	20	32	0 S	148	54	0 E
	Cape Gloucester .	19	57	0	148	25	0
	Cape Cleveland ..	19	5	0	147	5	0
	Cape Sandwich ..	18	19	0	146	29	0
	Cape Grafton	16	53	0	146	10	0
	Cape Flattery ...	14	57	0	145	35	0
	Cape York	10	39	30	142	33	0
	New Year's Island	10	55	0	133	4	0
	Vandieman's Land	11	12	0	129	54	0
	North West Cape	21	50	30	114	15	0
New Holland.	*Var.* 4° 0′ *W.* 1801						
	Dirk Hartog's Rd..						
	Entr. to Shark's B.	25	20	0	113	5	0
	Rottenest Island	31	58	0	115	24	30
	Cape Leuwen....	34	20	0	115	6	0
	Pt. D'Entrecasteau	34	52	0	116	1	0
	K. George's Sound	35	6	15	118	0	45
	Termination I....	34	30	20	121	58	0
	Investigators Gro.						
	—Flinders Island						
	S. W. Pt......	33	45	30	134	24	15
	Port Lincoln	34	48	25	135	44	51
	Cape Spencer....	35	18	0	136	53	0
	Cape Northumb.	38	2	30	140	37	30

XXI. Islands, Rocks, and Shoals, in the NORTH PACIFIC OCEAN.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Clerk's Islands...	63	15	0 N	169	40	0 W
	Gore's I. C. Upright	60	22	0	172	26	0
	Bhering's I., N. Pt.	55	36	0	167	46	0 E
	Copper I., S. Pt..	54	24	0	169	0	0
	Aleootskia I.,						
	—Westernmost...	52	46	0	170	42	0
	—Oonalaska	53	54	29	166	22	15 W
	Rica de Plata ...	33	50	0	160	39	0 E
	Rica de Oro.....	29	54	0	157	3	0
	Colunas.........	28	55	0	158	0	0
	St. Juan	27	30	0	142	48	0
	Sulphur Island...	24	48	0	141	20	0
	North Island	25	14	0	141	14	0
	Grampus Islands .	25	10	0	146	0	0
	Lobos Islands ...	24	50	0	146	58	0
	I. de Sebastian						
	Lobes.........	25	24	0	156	30	0
	Jardines	21	35	0	151	30	0
	——						
Ladrones.	Urracas.........	20	25	0	146	15	0
	Assumption Island	19	45	0	145	35	0
	Tinian	15	0	0	145	55	30
	Guam, Umatac B.	13	21	30	144	19	45
	——						
	Johannes........	6	55	0	132	30	0
	Lion's Island	5	16	0	132	23	0
	St. Andrew's Is...	5	20	0	132	16	0
	Pulo Anna	4	38	30	132	23	30
	Pulo Mariere	4	19	30	132	28	15
	Lord North's I. ..	3	3	0	131	4	15
	Dangerous Shoal	2	47	0	134	5	0
	Freewill, or						
	St. David's Is. ...	0	55	0	134	21	30
	——						
	Pelew Islands,						
	—Bablethoup, E. p	7	41	0 N	134	55	0 E
New Philippines, or Carolines.	—Northernmost .	8	8	30	134	50	0
	—Southernmost..	6	53	30	134	21	0
	Matelotes, NE. Id.	8	34	30	137	44	45
	Yap	9	35	30	138	8	0
	Philip Islands ...	8	6	0	140	3	0
	Thirteen Islands .	7	18	0	144	21	0
	Haweis Island ...	7	30	0	146	28	0
	Strong's Island...	5	12	0	162	58	0
	Palmyra I.	5	49	0	162	29	0
	Brown's Range ..	11	30	0	162	42	0
	Piscadores	11	15	0	167	20	20
	Muskitto Groupe	7	30	0	168	8	0
	Chatham Island..	9	20	0	171	20	0
	Mulgrave's Island	5	54	0	172	39	0
	Pitt's Island.....	2	54	0	174	30	0
	——						
	St. Bartholomew .	15	10	0	163	48	0
	Wake's Island ...	19	0	0	166	46	0
	Lamira, West Pt.	20	24	0	166	42	0
	Gasper Rico	15	12	0	171	18	0
	Wake's Rocks ...	17	48	0	173	45	0
	St. Pierre	11	6	0	179	0	0 W
	Barbados	8	54	0	178	21	0
	Necker Island ...	23	34	0	164	32	0
	French Frigate Bk.	23	45	0	165	50	0
	——						
	Owhyhee,						
Sandwich Islands.	—Karakakoa Bay	19	28	10	155	56	23
	Mowee, W. end..	20	53	30	156	38	30
	Tahoorowa	20	38	0	156	36	30
	Ranai	20	46	30	156	55	30
	Morotoi.........	21	10	0	157	17	0
	Woahoo.........	21	40	30	158	1	30
	Attoo, Whymea B.	21	57	0	159	39	30
	Oneeheow.......	21	45	0	160	10	0
	Birds Island.....	23	8	0	161	45	0
	——						
	Christmas, or						
	Noel Island	1	57	45	157	34	0
	Shelvoes Island ..	22	5	0	112	32	0
	Socoro I., middle	18	48	0	110	10	0
	Var. 7° *E.*						
	St. Berto........	19	18	0	109	53	0
	Rocka Partida...	19	4	30	111	6	30
	Passion Rock ...	16	56	0	109	5	0
	Cliporton Rock ..	10	27	0	109	18	0
	Cocos Island,						
	—Chatham Bay..	5	27	15	87	45	0
	——						
	Culpepper's Island	1	40	0	91	55	0
Gallepagos Islands.	Wenman's Island.	1	22	30	91	44	0
	Redondo Rock ..	0	15	0	91	34	0
	Abington Island,						
	—Cape Ibetson ..	0	29	0	90	43	40
	Var. 8° 40′ *E.*						
	Albemarle Island,						
	—Cape Berkley .	0	2	0	91	31	30
	—Christophers Pt.	0	50	0 S	91	25	0
	James I., Harbour	0	12	0	90	41	30
	Charles I., S. Pt.	1	30	0	90	33	0

LATITUDES AND LONGITUDES.

Places.	Latitude.			Longitude.		
	°	′	″	°	′	″
Chatham Island,						
—North East Pt..	0	45	0 S	89	9	0 W
—Stephens Bay..	0	53	0	89	37	0
Var. 8° 10′ *E.*						

XXII. Islands, Rocks, and Shoals, in the SOUTH PACIFIC OCEAN.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	New Guinea,						
	—C. of Good Hope	0	20	0 S	132	31	0 E
	—Cape Walsh ...	8	26	0	137	28	0
	—Cape Rodney..	10	3	30	147	48	0
	—K. William's C.	6	12	0	147	53	0
	Torres, or						
	Endeavour Straits,						
	—Deliverance I..	9	37	0	140	0	0
	—Booby Island..	10	36	30	141	56	0
	—Murray's Island	9	51	0	144	2	0
	Louisiade Isles,						
	—C. Deliverance	11	52	0	153	32	0
	Stephens Island..	0	16	0	137	48	0
	Durours Island ..	1	17	0	143	30	0
	Mattys Island ...	1	42	0	143	7	0
	Boudeuse	1	30	0	145	2	0
	Admiralty Island,						
	—West end	2	11	0	147	30	0
	Sydney Shoal....	3	20	0	146	50	0
	Portland Isles ...	2	29	0	148	32	0
	Matthias Island..	1	4	0	148	3	0
	Squally Island ...	1	22	0	149	36	0
	New Ireland,						
	—Cape St. George	4	54	0	152	59	0
	—Carteret's Harb.	4	48	0	152	46	0
	New Hanover,						
	—West end	2	25	0	149	6	0
	Sandwich Island .	2	59	30	149	45	0
	New Britain,						
	—Cape Palliser..	4	18	0	152	10	0
	—Cape Orford ..	5	40	0	152	21	0
	—Port Montague	6	12	0	151	2	0
	—Cape Ann	6	27	0	149	33	0
	Anson's I., N. Pt.	5	6	0	154	32	0
	Bouganville Strait	7	0	0	155	50	0
	Bridgewater Shoal	8	54	0	156	49	0
	—						
	Cape Satisfaction	8	6	0	156	30	0
	Cape Deception.	8	30	0	156	56	0
	Cape Nepean....	8	51	0	157	32	0
Solomon Islands.	Cape Marsh	9	7	0	158	26	0
	Cape Henslow ...	9	58	0	160	7	0
	Cape Philip	10	25	0	160	44	0
	Cape Sidney	10	52	0	161	32	0
	Cape Surville	11	0	0	162	18	0
	Bellona Island ...	11	6	0	159	37	0
	Bellona Shoal....	12	5	0	159	48	0
	Port Praslin	7	30	0	157	51	0
	Gower Island....	8	1	0	159	53	0
	Stewards Island..	8	24	0	163	0	0
	Ld Howe's Groupe	5	24	0	159	37	0
	—						
	Shank's Island ...	0	28	0	163	0	0

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Duff's Groupe,						
	—Disappointment						
	Island	9	57	0 S	167	0	0 E
	Egmont Island,						
	—Cape Byron ...	10	43	0	166	9	0
	Kennedy's I..	11	17	0	167	58	0
	Cherry Island ...	11	31	0	169	39	0
	Mitre Island	11	46	0	169	57	0
	Pandora's Reef ..	12	8	0	172	0	0
	—						
	Sir J. Banks' Is. .	13	27	0	167	24	0
	Cape Cumberland	14	39	30	166	47	0
	Bay St. Philip and						
	St. James	15	10	0	167	5	0
	Cape Quiros.....	14	56	8	167	20	0
	Lepers Island ...	15	23	30	167	58	15
	Maskelyne's I....	16	32	0	167	59	15
	Mallicolo,						
	—Port Sandwich	16	25	20	167	54	0
	Cape Lisburn....	15	40	45	166	57	0
	St. Bartholomew .	15	42	0	167	17	30
New Hebrides.	Aurora	15	8	0	168	17	0
	Table Island	15	38	0	167	7	0
	Whitsuntide I....	15	44	20	168	20	15
	Ambrym Island ..	16	9	30	168	12	30
	Paoom..........	16	30	0	168	28	45
	Apee	16	46	15	168	27	30
	Sheppard's Island	16	58	0	168	42	0
	Monument	17	14	15	168	38	15
	Hinchinbroke I. .	17	25	0	168	38	0
	Sandwich Island .	17	41	0	168	33	0
	Erromango,						
	—Traitors Head .	18	43	30	169	20	30
	Tanna,						
	—Port Resolution	19	32	25	169	41	0
	Erronam	19	39	0	170	15	0
	Enatum	20	10	0	170	4	0
	Walpole's Island .	22	39	0	169	16	0
	—						
	Bampton Shoal,						
	—North end.....	18	54	0	158	30	0
	Bellona Shoals...	19	7	0	159	48	0
	Booby Shoal	19	0	0	159	3	0
	—						
	Balleabea Island .	20	7	0	164	22	0
	Pudyona	20	18	0	164	41	14
New Caledonia.	Cape Colnet.....	20	30	0	164	56	0
	Cape Coronation .	22	5	0	167	8	0
	Queen Charlotte's						
	Foreland	22	15	0	167	12	45
	Isle of Pines.....	22	42	0	167	34	0
	Botany Island ...	22	26	40	167	16	45
	Pr. of Wales' Fore-						
	land	22	25	0	166	52	0
	Loyalty Islands ..	20	54	0	166	30	0
	—						
	Ray's Island.....	25	0	0	166	21	0
	Sir C. Middleton's						
	Island	28	12	0	160	32	0
	Middleton's Shoals	29	18	0	159	28	0
	Lord Howe's I.	31	30	0	159	0	0
	Norfolk Island ..	29	1	45	168	10	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	——						
	North Cape	34	27	0 S	173	4	0 E
	Cape Bren	35	10	0	175	0	0
	Cape Colville....	36	24	45	175	48	50
	Mercury Bay....	36	48	0	176	6	20
	Cape East.. ..	37	44	25	178	58	0
	Tolaga Bay	38	22	0	178	35	54
	Table Cape	39	6	40	178	2	20
	Cape Kidnappers	39	42	45	177	16	0
	Cape Turnagain .	40	32	30	176	49	0
	Banks' I., E. end.	43	43	0	173	3	55
New Zealand.	Cape Saunders...	45	37	45	170	16	0
	Molineaux Harbor	46	8	0	169	41	0
	The Snares	48	3	0	166	20	0
	Cape South......	47	16	50	167	20	9
	South West Bay .	46	30	0	167	25	0
	Solander's Island.	46	28	0	166	33	0
	West Cape	45	56	15	166	6	15
	Dusky Bay......	45	45	36	166	15	54
	Open Bay.......	43	51	0	168	43	0
	Cape Foulweather	41	58	0	171	30	0
	Cape Farewell ...	40	40	0	173	18	0
	Queen Charlotte's Sound	41	5	57	174	40	0
	Cape Campbell ..	41	34	0	174	56	0
	Cape Paliser	41	24	0	175	41	0
	Cape Egmont....	39	23	20	174	12	30
	Gannet Island ...	38	5	0	175	5	0
	——						
	Auckland's Group	50	30	0	166	25	0
	Bounty Isles.....	47	35	0	179	6	0
	Chatham Island,						
	—Cape Young...	43	48	0	176	58	0W
	Macauley Island .	30	8	0.	179	0	0
	Sunday Island ...	29	12	0	178	13	0
	Vasques.........	25	40	0	174	56	0
	——						
	Rotumah Island..	12	30	0	177	0	0 E
	Solitary Island...	10	40	0	176	0	0W
	D. of Clarence's I.	9	11	0	171	30	0
	D. of York's I. ..	8	29	0	172	22	0
	Quiros Island....	10	40	0	169	54	0
	Jesus Island	6	46	0	166	0	0
	St. Bernard's I...	10	51	0	167	10	0
	Wallis's Island ...	13	30	0	176	5	0
	Forlorn Hope ...	14	16	0	176	56	0
Friendly Islands.	Proby Island	16	0	0	175	50	0
	Keppel's Island ..	15	53	0	174	12	0
	Boscawen's Island	15	50	0	174	7	40
	Navigator's Is.,						
	—Opoun, E. Pt..	14	9	10	169	1	50
	—Leone, S. Pt...	14	7	53	169	16	22
	—Tanfoue, E. Pt.	14	5	23	169	18	27
	—Maouna,						
	—Massacre Cove	14	20	45	170	16	50
	—Oyolava, E. Pt.	14	2	40	171	7	15
	Calinasse, N. Pt..	13	45	0	171	51	33
	—Pola, N. E. Pt.	13	27	33	171	56	43
	Amargura	18	0	0	174	35	0
	Vavaon,						
	—Port Refuge...	18	50	0	174	0	0
	Lati Island	18	54	0	174	48	0
	Savage Island ...	19	2	15	169	30	30

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
Friendly Islands.	Toofoa.	19	51	0 S	175	6	0W
	Hapae, North Pt.	19	48	0	174	5	0
	Annamooka, or Rotterdam Island	20	15	20	174	45	0
	Tongataboo, or Amsterdam Island	21	8	36	175	1	50
	Eoaa	21	24	0	174	30	0
	Pylstaart's Island.	22	23	30	175	49	30
	——						
	Palmerston Island	18	0	30	163	12	0
	Whylootack	18	58	0	159	48	0
	Harvey's Island..	19	17	0	158	56	20
	Watcoo Island ...	20	1	30	158	14	30
	Mangeea Island..	21	56	45	158	3	0
	——						
	Scilly Island.....	16	30	0	155	10	0
	Lord Howe's I. ..	16	46	30	154	6	40
	Marua Island....	16	25	40	152	32	40
	Bolabola Island..	16	32	30	151	52	0
Society Islands.	Ulietea	16	45	35	151	31	0
	Huaheine,						
	—Owharre Bay..	16	42	45	151	9	0
	Sir C. Sanders' I.	17	25	0	150	58	0
	Emao...........	17	30	0	150	10	0
	Tethuroa........	17	1	0	149	36	0
	Otaheite,						
	—Point Venus...	17	29	17	149	35	45
	—Otooareite	17	55	0	149	12	0
	Osnaburg, or Miatea..........	17	52	20	148	6	0
	——						
	Pr. of Wales's I.,						
	—North Point...	14	58	0	147	50	0
	Recreation Island	15	58	0	148	48	0
	Palliser's Island..	15	38	15	146	30	15
	Chain Island	17	25	30	145	30	0
	Gloucester Island	20	31	0	145	54	0
	Ohetiroa	22	26	36	150	48	45
	Toobouai	23	25	0	149	20	30
	High Island	23	42	0	148	3	0
	Byron's Islands,						
	—Taoukaa Island	14	30	30	145	9	30
	Disappointment Islands	14	7	0	141	22	0
	Adventure Island	17	10	0	144	30	0
	Furneaux Island .	17	11	0	143	6	40
	Resolution Island	17	23	30	141	45	0
	——						
Dangerous Archipelago.	Bird Island......	17	49	0	142	43	24
	Bow Island	18	17	0	140	43	0
	Pr. Henry's Island	19	0	0	141	22	0
	Cumberland I....	19	18	0	140	52	0
	Gloucester Island	19	11	0	140	20	0
	Q. Charlotte's I. .	19	18	0	138	20	0
	Whitsunday I....	19	26	0	138	12	0
	Lagoon Island ...	18	48	0	138	33	0
	——						
	Osnaburg Island .	22	8	0	140	37	0
	Blight Lagoon I..	21	43	0	140	30	0
	Carysfoot Island .	21	0	0	138	26	0
	Lord Hood's I. ..	21	42	0	135	32	0
	Porpoise Shoal ..	22	11	38	135	35	36

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Gambier's Island.	23	12	0 S	134	59	0 W
	Crescent	23	22	0	134	30	0
	Pitcairn's Island .	25	4	0	130	25	0
	St. Juan Baptista	25	57	0	137	56	0
	Opaio	27	36	0	144	11	15
	Robert's Island .	8	3	0	140	30	0
	Nooaheevah	8	57	0	139	54	0
	Rooahoogah	9	0	0	139	27	0
Marquesas.	Hood's Island ...	9	26	0	138	52	0
	Rooapooh	9	30	0	140	0	0
	Var. 4° 24′						
	Ohevahoa	9	40	40	139	1	40
	St. Christiana, —Resolution Bay	9	55	30	139	8	40
	Onateaya	9	58	0	138	51	0
	Magdalena	10	25	30	138	49	0
	Penrhyn's Island.	9	12	0	157	43	0
	Ducie's Island ..	24	40	0	124	37	0
	Easter Island	27	9	30	109	25	20
	Felix	26	16	20	80	3	0
	Var. 12° 10′ *E.*						
	Ambrose	26	19	40	79	51	0
	Afuera	33	45	0	80	42	0
	Juan Fernandez ·	33	40	0	78	58	13

XXIII. The WEST COAST of AMERICA.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	CAPE HORN.....	55	58	30 S	67	21	14 W
Terra del Fuego.	Diego Ramirez I.	56	28	0	68	40	0
	Var. 21° 56′ *E.*						
	St. Ildefonzo Is...	55	55	0	69	18	0
	Christmas Sound .	55	25	0	69	50	0
	Gilbert's Island ..	55	13	0	70	56	45
	Cape Desolation .	54	55	0	71	42	0
	Cape Noir.......	54	30	30	73	15	0
	Cape Gloucester .	54	7	0	73	35	0
	Cape Pilar	52	45	0	74	54	0
	Cape Victory	52	23	0	74	56	0
	Madre de Dios, —C. Santiago	50	54	0	75	30	0
	Var. 22° 30′ *E.*						
	Cape Corzo	49	26	0	75	46	0
	Cape Tres Montes	46	59	0	75	27	0
	Cape Taytan	45	51	0	75	28	0
	Chiloe, Castro ...	42	41	0	74	3	30
	—Pt. Quilan	43	41	0	74	19	30
	—St. Carlos	41	53	0	73	50	0
	Var. 18° *E.*						
Coast of Chili.	Quidal Point	41	5	0	74	5	0
	Valdivia	39	51	0	73	26	30
	Mocha Island....	38	22	30	73	59	0
	Sta. Maria Islands	37	1	0	73	35	45
	Conception......	36	42	21	73	0	0
	Santiago	33	30	0	70	56	0
	Valparaiso	33	1	55	71	40	26
	Coquimbo	29	54	26 S	71	19	0 W
	Choros Point . .	28	50	0	71	30	0
	Copiapo	27	10	0	71	5	0
	Blanca Island ...	24	57	0	70	35	0
	Morro Moreno...	23	19	0	70	27	0
	Solitary Island...	22	58	0	70	15	0
	I. de Iquiqua....	20	14	0	70	13	0
	Arica...........	18	26	38	70	16	0
	Var. 10° 30′ *E.*						
Coast of Peru.	Ylo.............	17	36	15	71	9	45
	Port Caballos....	15	5	0	75	31	0
	Pisco	13	45	0	76	13	0
	LIMA	12	3	15	76	56	45
	Callao Castle	12	3	38	77	4	19
	St. Martin's I. ...	11	6	0	77	31	0
	Truxillo	8	9	0	78	51	0
	Lobos de Mer ...	6	56	0	80	49	0
	Lobos de Tierre .	6	28	0	80	48	0
	Punta de Auxa ..	5	58	0	81	4	0
	Paita	5	3	0	80	59	0
	Cape Blanco	4	15	0	81	9	0
	Picos Point	3	39	0	80	32	0
	Guayaquil.......	2	11	30	79	41	15
	Pt. St. Helena ...	2	10	0	80	47	0
Quito.	Cape de Lorenzo.	1	4	0	80	43	0
	Cape Passado . ..	0	27	0	80	19	15
	Quito...........	0	13	17	78	21	30
	C. St. Francisco..	0	40	0 N	79	53	0
	Esmeraldas	0	54	0	79	24	0
	Tumaco Island ..	1	46	0	78	38	30
	Cape Corentes...	5	34	0	77	16	0
	PANAMA........	8	57	30	79	18	30
	Point Mala... ..	7	23	0	79	51	0
	Cape Marietta...	7	14	0	80	37	0
Mexico, or New Spain.	Malpelo Island ..	3	59	0	80	11	30
	Quibo Island, —S. E. Cape	7	21	0	81	28	0
	Point Burcia	8	3	0	82	51	0
	Cape Blanco.....	9	13	0	85	28	0
	Pt. St. Catherine.	10	24	0	86	21	0
	Leon	11	50	30	87	9	0
	Point Gatimala ..	13	54	0	90	53	0
	Puerto Ventosa ..	16	6	0	95	22	0
	Agualco	16	2	0	96	52	0
	Acapulco	16	51	0	99	54	0
	Cape Correntes ..	20	32	0	105	35	0
	St. Blas.........	21	30	0	104	46	0
	Tres Marias	21	28	0	106	29	0
	St. Joseph.......	23	3	42	109	42	30
	Cape St. Lucar ..	22	44	0	109	54	0
	Morro Hermoza..	27	46	0	114	41	0
	Redonda Island..	29	49	0	115	10	0
	Bay St. Francisco	30	23	0	115	36	0
New Albion.	B. Todos Santos .	31	56	0	116	22	0
	Port Diego......	32	42	30	116	53	15
	Point Conception	34	32	0	120	6	0
	Monterry	36	36	20	121	34	15
	Port St. Francisco	37	48	30	122	7	30
	Cape Mendocino.	40	19	0	124	7	0
	Port Trinidad ...	41	3	0	123	54	0
	Var. 16° 0′ *E.*						

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Cape Blanco, or Orford	42	52	0 N	124	25	0 W
	Cape Gregory	43	29	0	124	9	0
	Cape Perpetua	44	12	0	123	55	0
	Cape Foulweather	44	49	0	123	56	0
	Cape Lookout	45	32	0	123	49	0
	C. Disappointment	46	19	0	123	54	0
	Var. 20° 0′ *E.*						
	Gray's Harbour	47	0	0	123	53	0
	Point Grenville	47	22	0	124	1	30
	Cape Flattery	48	23	30	124	22	0
	Port St. Juan	48	34	0	124	8	0
Vancouver's I.	Nootka Sound	49	34	20	126	28	30
	Woody Point	50	6	0	127	43	0
	Cape Scott	50	48	0	128	20	0
	Scott's, or Sartine's Islands	50	52	0	129	0	0
	Point Chatham	50	19	30	125	15	0
	Pta. de Gonzalo	48	28	0	122	53	0
	Cape Caution	51	12	0	127	51	0
	Cape Swaine	52	13	0	128	20	0
	Calamity Harbour	53	10	30	129	34	0
	Cape Ibbetson	54	4	0	130	30	0
	Brown's Passage	54	20	0	130	32	0
	Cape de Chacon	54	43	0	131	45	0
	Cape de Muzon	54	42	0	132	30	0
Q. Charlotte's I.	C. St. James, or Hector	51	57	30	131	6	0
	Cape Henry	52	53	0	132	26	30
	Point Buck	53	10	0	132	40	0
	Point Hunter	53	19	0	132	47	0
	Langara, or North Island	54	20	0	133	12	30
	Point Imbisible	54	12	0	131	30	0
	Forresters, or St. Carlos Island, —North Pt.	54	53	0	133	21	0
	Point Bucarelli	55	12	0	133	25	0
	Cape Addington	55	26	30	133	37	0
	Cape Pole	55	58	0	133	33	0
	Cape Decision	56	2	0	133	52	0
	Hazy Islands	55	54	0	134	18	0
	Cape Ommaney	56	10	0	134	23	0
	Norfolk Sound, —C. Edgecumbe	57	2	0	135	34	0
	Cape Cross	57	55	30	136	17	0
	Var. 30° 0′ *E.*						
	Cape Spencer	58	13	0	136	24	0
	Cape Fairweather	58	50	30	137	55	0
	Port des Francois	58	37	0	137	45	0
	Beeringhs Bay	59	9	0	138	24	0
	Admiralty Bay, —Point Phipps	59	33	0	139	54	0
	Point Riou	59	54	0	141	30	0
	Mt. St. Elias	60	22	30	141	0	0
	Cape Suckling	60	1	0	143	42	0
	Cape Hammond	59	48	30	144	26	0
	Pr. William's Sd., —C. Hinchinbroke	60	16	30 N	146	26	0 W
	—Port Chalmers	60	16	0	147	5	0
	Var. 28° 30′ *E.*						
	—C. Puget	59	54	30	148	19	0
	Middleton's, or Rose Island	59	32	0	146	22	0
	Chiswell's Islands, —South Point	59	31	0	149	24	0
	Cape Elizabeth	59	9	0	151	27	0
Cook's Inlet.	Port Chatham	59	14	0	151	14	0
	Var. 24° 0′ *E.*						
	Anchor Point	59	39	0	151	39	0
	East Foreland	60	43	0	150	58	0
	West Foreland	60	42	0	151	16	0
	Point Campbell	61	8	0	149	38	0
	Point Harriott	60	24	0	151	48	0
	Cape Douglas	58	52	0	152	50	0
Kodiak.	Point Banks	58	40	0	152	6	0
	I. St. Hermogenes	58	10	30	151	30	0
	Cape Grenville	57	34	30	152	0	0
	Cape Barnabas	57	10	0	152	39	0
	Cape Trinity	56	45	0	153	38	0
	Trinity Islands	56	33	30	153	36	0
	Tscherikow Is.	55	49	0	155	8	0
	Schoomagen I., —North West Pt.	55	15	0	159	48	0
	Halibut Islands, —S. E. Pt.	54	23	0	162	27	0
	Oonalaska	53	54	29	166	22	15
	Bristol R. entr.	58	12	0	157	33	0
	Round Island	58	29	0	159	53	0
Beering's Straits.	Cape Newnham	58	34	0	161	55	0
	Shoalness	60	0	0	161	52	0
	Cape Stephens	63	33	30	162	17	0
	Cape Denbigh	64	17	0	161	53	0
	Cape Rodney	64	34	0	166	37	0
	Cape Pr. of Wales	65	45	30	168	17	30
	Cape Mulgrave	67	45	30	165	12	0
	Cape Lisburne	69	5	0	165	22	30
	Icy Cape	70	29	0	161	42	30

XXIV. The EAST COAST of AMERICA, from Cape Horn to Cape Florida.

	Places.	Latitude.			Longitude.		
	CAPE HORN	55	58	30 S	67	21	14 W
Terra del Fuego.	Staten Island, —Cape St. John	54	47	10	63	42	30
	Var. 22° *E.*						
	Le Maire's Straits, —C. Good Success	55	1	30	65	17	30
	Cape Sta. Ines	54	8	0	66	57	45
	Cape St. Sebastian	53	27	0	67	59	0
	Str. of Magellan, —Q. Catherine's Foreland	52	41	0	68	25	30

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	—Cape Virginis	52	21	30 S	68	17	40W
	—Cape Froward	53	53	20	71	10	30
	Cape Fairweather	51	33	0	69	0	0
Patagonia.	Sta. Cruz, Harb.	50	17	30	68	28	0
	Port St. Julian	49	7	0	67	42	0
	Port Desire	47	45	0	66	0	0
	Cape Blanco	47	17	0	65	56	0
	Var. 21° 54′ *E.*						
	St. George's Bay,						
	—Port Cordova	45	45	0	67	26	0
	Port St. Elena Obs.	44	29	45	65	27	15
	Port St. Antonio	40	54	0	64	40	0
	Cape Corrientes	38	0	0	57	41	0
	River Plate,						
	—C. St. Antonio	36	20	0	56	35	0
Paraguay.	*Var.* 14° 10′ *E.*						
	—BUENOS AYRES	34	36	40	58	13	38
	—Colonia del Sacramento	34	28	0	57	41	0
	—Montevedio	34	54	48	56	3	30
	Maldonado Harb.,						
	—Gorriti Island	34	56	19	54	40	0
	Cape St. Maria	34	40	0	53	56	0
	Rio Grande de San Pedro	32	10	0	52	3	0
	Morros de S. Maria	28	55	0	48	18	0
	St. Catherine's I.,						
	—North Point	27	19	10	47	40	0
	—South Point	27	49	0	47	49	0
	Paranagua Harbor	25	31	30	47	45	0
	Santos, entr. to	24	4	0	46	5	0
	St. Sebastian's I.,						
Brazil.	—Armasao	23	44	30	45	13	0
	Grand Island	23	18	0	44	0	0
	RIO JANEIRO	22	54	10	43	3	0
	Cape Frio	23	1	0	42	0	0
	Var. 5° 40′ *E.*						
	Cape St. Thomas	22	0	0	40	55	0
	Espiritu Santo	20	15	0	39	28	0
	Abrolhos Islands	17	58	0	38	26	0
	Porto Seguro	16	40	0	39	0	0
	Bahia, C. St. Antonio	12	59	0	38	25	0
	R. St. Francisco	10	57	0	36	14	0
	Cape St. Augustine	8	23	0	34	56	0
	Pernambuco	8	3	0	34	52	0
	Olinde	8	0	0	34	50	0
	Cape Ledo	6	50	0	35	7	0
	Cape St. Roque	5	10	0	35	40	0
	Seara	3	50	0	38	28	0
	St. Anna	2	18	0	43	43	0
	St. Louis de Maranham	2	29	0	44	5	0
	River Para, entr.	0	20	0	48	20	0
	Riv. Amazon, entr.	1	25	0 N	50	5	0
	Cape North	1	51	0	50	15	0
Guayana.	R. Cassipour	3	54	0	51	10	0
	Cape Orange	4	8	0	51	20	0
	Oyapok River,						
	—St. Louis	3	57	0	51	40	0
	CAYENNE	4	56	15	52	16	30
	R. Maroni, Port	5	44	0	53	55	30
	Surinam, Brams Pt.	5	52	0 N	55	15	30W
	Paramaribo	5	43	35	55	15	0
	R. Berbice, entr.	6	29	0	37	11	0
	Fort Nassau	5	54	0	57	15	0
	R. Demerari,						
	—Corrobano Pt.	6	48	0	58	1	37
	R. Essequebo, entr.	7	0	0	58	11	0
	Cape Nassau	7	34	0	58	54	0
	Cape Barma	8	40	0	60	14	0
	R. Oronoko, entr.	8	46	0	60	18	0
	Testigos Islands	11	23	15	63	10	30
	Blanca, N. Point	11	54	30	64	42	0
	Var. 3° 50′ *E.*						
Leeward Islands.	Margarita,						
	—Galera Point	11	6	30	64	4	30
	Tortuga, E. end	10	54	45	65	16	30
	Orchilla, E. end	11	49	45	66	9	15
	Roca, N. E. Pt.	11	58	30	66	42	20
	Aves, E. Island	11	57	30	67	30	30
	Buen Ayre. N. Point	12	19	15	68	30	0
	Curaçao, N. Point	12	24	0	69	16	20
	—Amsterdam, Hr.	12	6	15	69	0	45
	Var. 2° 25′ *E.*						
	Oruba, E. end	12	23	45	69	59	30
	Cape Three Points	10	45	15	62	45	50
	Cumana	10	27	45	64	16	30
	Cape Coadera	10	35	54	66	11	30
	Guayra	10	36	40	67	1	30
	Caracas	10	30	0	67	0	55
Columbia.	Porto Cabello	10	29	50	68	7	35
	Cape Roman	12	11	0	70	8	30
	Maracaybo	10	39	0	71	44	0
	Monks Islands	12	30	0	70	58	0
	Cape de la Vela	12	11	0	72	15	35
	Sta. Marta	11	15	2	74	17	30
	CARTHAGENA	10	25	19	75	37	15
	G. of Darien, entr.	8	33	0	77	0	0
	PORTO BELLO	9	34	30	79	43	15
	Blewfields R., entr.	11	58	0	82	55	0
	Great Corn Island,						
	—North end	12	13	0	82	10	0
	Little Corn Island	12	18	0	82	6	0
	St. Andrew's I.	12	31	0	80	59	0
	C. Gracios a Dios	14	56	30	82	45	0
	Black R., entr.	15	58	0	84	58	0
	Cape Cameron	16	2	0	85	10	0
	Cape Delgado	16	1	0	86	10	0
	Truxillo	15	51	0	86	6	0
Bay of Honduras.	Swan Islands	17	22	0	83	56	0
	Bonacio Island,						
	—North East Pt.	16	31	0	85	47	0
	Rattan I., E. Pt.	16	26	0	86	20	0
	Utilo, E. Point	16	3	0	87	2	0
	Glover's Reef,						
	—North Point	16	49	0	87	36	0
	—South Point	16	28	0	87	52	0
	N. Triangles,						
	—North Point	19	1	0	87	43	0
	—South Point	18	29	0	87	42	0

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Cozumel Island,						
	—South Point.....	20	1	0 N	87	2	0 W
	Punta Brava......	21	0	0	86	44	0
	Mugeres I.........	21	7	0	86	42	0
	C. Catouche.......	21	33	0	86	57	30
	Point Palmar	20	58	0	90	18	0
	Campeche	19	51	0	90	28	15
	VERA CRUZ	19	11	52	96	8	45
	MEXICO	19	25	50	99	5	15
	Cape Roxa........	21	35	0	97	18	0
W. Florida.	River Bravo, entr. .	25	55	0	97	25	0
	St. Louis Island,						
	—East end.........	29	10	0	96	5	0
	R. Mississipi, entr..	29	5	0	89	8	0
	New Orleans.....	29	57	45	90	8	45
	Mobile Point......	30	10	0	88	0	0
	Pensacola	30	25	0	87	29	0
	Cape St. Blas	29	41	0	86	2	0
	Bay of Apalache ..	30	0	0	84	45	0
E. Florida.	Spiritu Santo, Hr. .	27	38	0	83	20	0
	Carlos Bay	26	29	0	82	33	0
	Point Larga	25	38	0	82	3	0
	Dry Tortugas	24	31	0	83	0	0
	Var. 6° 15′ *E.*						
	Cape Sable	25	2	0	81	15	0
	Cape Florida......	25	41	30	80	5	0

XXV. The WEST-INDIA ISLANDS.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Bermudas,						
	—St. George Town	32	22	0 N	64	33	0 W
	—Wreck Hill, or West end.......	32	15	20	64	50	0
	—S. W. Reef	32	9	0	64	57	0
	—Northern Rock ..	32	33	30	64	37	0
	——						
Little Bahama Bank.	Matanilla Reef,						
	—North end	27	34	0	79	9	0
	Memory Rock	26	55	0	79	2	0
	Great Bahama,						
	—West end.......	26	41	0	79	2	0
	—East end	26	28	0	77	50	0
	Hole in the Rock ..	25	50	0	77	7	30
	North East Point..	26	17	0	76	56	0
	Abaco Key S. Pt. .	26	25	0	76	54	0
	Elbow Key S. Pt .	26	35	0	76	55	0
	Seal Key.........	27	1	0	78	16	0
	——						
	Berry Isles,						
	—Stirrup Key.....	25	47	45	77	52	0
	—Frozen Keys.....	25	30	0	77	38	0
	Salt Key Bank,						
	—Water Key	24	0	0	80	0	0
	—Salt Key	23	41	0	80	7	0
	—Anguilla........	23	29	0	79	13	0
	——						
	Great Isaac.......	26	2	15	79	2	30
	Little Isaac......	25	57	0	78	49	0
	Bemini Islands...	25	40	0	79	16	0
	Ginger, or						
	Dutch Key	22	47	0 N	77	58	0 W
	Lobos Key.........	22	24	0	77	28	0
	Diamond Point....	22	10	0	77	12	0
	Orange Key	24	54	0	79	7	0
	Beak's Key	25	23	0	79	11	0
Great Bahama Bank.	New Providence,						
	—Nassau.........	25	5	20	77	19	0
	—West end.......	25	0	0	77	37	0
	—East end	25	1	0	77	13	0
	Egg Island	25	31	0	76	53	0
	Harbour Island,						
	—North Pt........	25	30	0	76	37	0
	Eleuthera Island,						
	—Powell's Point ..	24	37	0	76	9	0
	Exuma Island,						
	—North West Pt. .	23	39	0	75	45	0
	Yuma, or Long I.,						
	—North West Pt. .	23	32	0	75	37	0
	—South East Pt. ..	22	52	0	74	50	0
	Key Verde	22	2	0	75	2	0
	——						
	Leeward Stocking Island..........	23	52	0	75	50	0
	Cat Island, N. Pt..	24	37	0	75	36	0
	—South Point.....	23	57	0	75	17	0
	Little Island	24	26	0	75	50	0
	——						
	Watling's Island,						
	—North East Pt...	24	8	0	74	19	0
	—S. W. Point.....	23	56	30	74	30	0
	Rum Island.......	23	39	0	74	45	0
	Var. 6° *E.*						
	Atwood's Key,						
	—West Point	23	9	10	73	47	40
	—East Point	23	10	0	73	37	0
	Crooked Island,						
	—West Point.....	22	48	50	74	19	0
	—East Point......	22	43	0	73	48	0
Passage Islands.	Acklin's Key,						
	—Castle Island ...	22	[illegible]	30	74	17	0
	Long Key,						
	—South West Pt...	22	28	0	74	18	0
	Mira por vos Keys.	22	8	0	74	33	40
	Flat Keys,						
	—West End.......	22	42	30	73	33	0
	Mogane Island,						
	—North West Pt...	22	30	40	73	8	0
	—South West Pt...	22	21	40	73	11	0
	—East Reef	22	20	0	72	43	30
	Hogsties, W. Pt. ..	21	40	40	73	54	0
	Little Heneaga,						
	—East Point......	21	29	0	72	55	20
	—West Point	21	29	0	73	6	0
	Great Heneaga,						
	—North East Pt...	21	23	0	73	1	0
	—North West Pt. .	21	9	0	73	40	30
	—South West Pt...	20	56	0	73	40	0
	——						
	Gt. Caycos, S. Pt. .	21	34	0	71	27	0
	Shoal off C. Comet.	21	47	15	71	20	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
Caycos Islands.	Booby Rocks, off North Caycos...	21	57	30N	72	4	45W
	Providence Caycos,						
	—North West Pt. .	21	50	0	72	21	30
	Little Caycos,						
	—South West Pt. .	21	36	15	72	26	0
	Sandy Key	21	18	40	72	2	40
	South Keys	21	1	0	71	30	15
	———						
	Turks Islands,						
	—Grand Turk	21	31	45	71	4	30
	—Salt Key	21	21	0	71	7	0
	—Sand Key	21	11	0	71	8	42
	—Endymions Rks.	21	6	0	71	15	0
	Sq. Handkerchief,						
	—North East end .	21	23	0	70	24	0
	—North West end	21	23	0	70	32	0
	—South West end .	20	53	0	70	55	40
	Silver Keys,						
	—South East end . .	20	13	50	69	27	45
	—North East end .	20	31	0	69	26	0
	—West end.......	20	30	0	69	59	0
	———						
Cuba.	Cape Maize	20	13	40	74	1	15
	Point Mulas......	21	10	0	75	31	0
	Cayo Romano	21	53	0	77	36	45
	Point Paridon	22	28	0	78	4	0
	Cruz del Padre....	23	14	0	80	56	30
	Point Ycacos.....	23	9	0	81	10	0
	Fort Matancas....	23	1	39	81	34	30
	HAVANNA,						
	—Fort Morro.....	23	9	26	82	15	36
	Honda Bay	22	59	0	83	7	0
	Cape Antonio	21	5	0	84	58	30
	Cape Corrientes ..	21	42	30	84	23	30
	Isle of Pines,						
	—S. W. end	21	32	0	82	59	0
	—Hills	21	35	0	82	37	0
	Cape Crúz	19	47	16	77	40	30
	Cuba	19	57	20	76	4	30
	Cumberland Harb.	19	53	30	75	10	20
	———						
Jamaica.	Morant Point.....	17	58	0	76	5	0
	North East Point .	18	13	0	76	15	30
	Port Antonio	18	15	0	76	23	0
	Galina Point	18	29	30	76	54	0
	St. Ann's.........	18	30	30	77	16	0
	Martha Brae	18	32	0	77	44	0
	Montego Bay.....	18	32	0	78	2	30
	North Negril	18	24	0	78	30	0
	South Negril	18	15	45	78	32	0
	John's Point......	18	11	30	78	22	30
	Savannah la Mer. .	18	13	0	78	15	0
	Portland Point ...	17	42	30	77	8	30
	Port Royal	17	58	20	76	48	45
	KINGSTON	18	0	30	76	45	0
	———						
Caymans.	Caymanbrack W.pt	19	39	0	79	48	0
	Little Cayman	19	36	0	80	5	0
	Grand Cayman,						
	—South West Pt. .	19	12	0	81	26	0
	—North East Pt...	19	18	0N	81	0	0W
	Var. 7° 50′ *E.*						
	Swan Islands	17	22	0	83	56	0
	Pedro Shoals,						
	—Rattle Snake ...	17	24	0	78	56	0
	—Portland Rock . .	17	14	0	77	10	0
	Morant Keys,						
	—North East Key	17	26	0	75	54	0
	—South West Key	17	23	45	75	56	0
	Formigas Shoal,						
	—North East Pt...	18	34	30	75	38	0
	—South East Pt. . .	18	28	30	75	40	0
	—South West Pt...	18	28	0	75	48	0
	Navassa	18	23	30	75	0	0
	———						
St. Domingo, or Hispaniola.	Cape St. Nicholas.	19	49	20	73	28	5
	Point St. Mark ...	19	2	18	72	48	19
	Gonave, S. E. Pt. .	18	48	35	72	49	47
	—West Point.....	18	57	0	73	17	0
	PORT AU PRINCE.	18	33	42	72	22	20
	Petit Goave	18	26	50	72	50	55
	The Caymites	18	40	0	73	42	0
	Fort Jeremy......	18	40	30	74	7	8
	C. Donna Maria . .	18	37	20	74	26	0
	C. Tiberon	18	19	25	74	27	32
	Point Abacou	18	1	30	73	46	0
	Fort St. Louis	18	14	30	73	31	30
	Altavella.........	17	28	0	71	22	30
	Cape Beata	17	42	30	71	20	0
	ST. DOMINGO	18	28	40	69	52	54
	St. Catherine's I...	18	19	0	69	1	0
	Cape Enganno....	18	34	30	68	20	30
	Cape Raphael	19	2	0	68	52	30
	Cape Samana.....	19	17	40	69	7	15
	Cape Cabron	19	21	0	69	12	47
	Old Cape Francois	19	40	30	69	55	20
	Point Isabella	19	59	0	71	10	25
	La Grange	19	54	30	71	42	50
	Rock off Point La Grange	20	0	30	71	40	25
	Port Dauphin	19	38	30	71	53	0
	Cape Henry, Town	19	46	30	72	15	20
	Tortudas, E. Pt...	20	0	55	72	35	55
	—West Point.....	20	5	20	72	54	56
	———						
	La Mona.........	18	6	0	67	49	45
	La Monica	18	9	0	67	51	0
	Zachée Island	18	24	30	67	22	30
	———						
Porto Rico.	Point Bruquin....	18	31	0	67	8	0
	Porto Rico.......	18	29	10	66	5	34
	Cape St. Juan	18	24	0	65	38	30
	Point Carrelas	17	57	0	65	56	0
	Los Morillos......	17	56	0	67	9	30
	———						
Virgin Islands.	St. Thomas's Harb.	18	18	16	64	58	15
	Tortola, Bay	18	23	30	64	39	0
	St. John's, E. Pt...	18	18	0	64	43	0
	Birds Key	18	13	0	64	55	0
	Virgin Gorda,						
	—East end	18	30	50	64	21	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Anegada, W. Pt....	18	47	30N	64	18	30W
	Santa Cruz, Town.	17	44	8	64	43	30
	Sombrero	18	37	0	63	29	30
	Anguilla, W. Pt....	18	11	30	63	16	30
	St. Martin,						
	—Great Bay	18	1	20	63	7	0
	St. Bartholomew,						
	—East Point	17	53	35	62	52	30
	Saba	17	39	20	63	19	0
	Aves, or Birds Is..	15	50	18	63	43	0
	St. Eustatius, Town	17	29	30	63	4	30
	St. Christopher,						
	—Basse Terre	17	19	30	62	49	20
	Nevis, Town	17	10	30	62	43	0
	Barbuda, N. Pt. ..	17	46	45	62	2	0
	Antigua,						
	—St. John	17	9	30	61	54	0
	—English Harb. ..	17	3	0	61	50	0
	Redondo	16	55	0	62	28	0
	Montserrat,						
	—North East Pt...	16	48	0	62	16	40
	Guadaloupe,						
	—Fort Louis	16	15	0	61	35	0
	—Chateau Point ..	16	13	0	61	14	0
	—Old Fort Point .	15	56	0	61	46	0
	—Bassa Terre	15	59	30	61	48	15
	—English Head...	16	23	0	61	51	0
	Deseada Island,						
Caribbee Islands.	—North Pt.	16	20	0	61	7	0
	Saints Islands	15	54	0	61	38	0
	Marygalante,						
	—Town..........	15	52	15	61	22	0
	Dominica,						
	—Pr. Rupert's Bay	15	35	30	61	33	0
	—Roseau	15	18	23	61	28	0
	—Scot's Head	15	12	0	61	26	0
	Martinique,						
	—Port Royal.....	14	35	55	61	7	30
	—Port St. Pierre..	14	44	0	61	17	0
	—Moncaba Point .	14	54	0	61	21	0
	—Cape Salines....	14	23	0	60	5	0
	—Diamond Rock .	14	25	0	61		30
	St. Lucia,						
	—Careenage	13	57	0	61	7	0
	—Point Piton	13	42	0	61	13	0
	—Moulacique Pt. .	13	35	0	61	2	0
	St. Vincent,						
	—Kingston.......	13	9	0	61	15	0
	Barbadoes,						
	—North Point....	13	19	0	59	44	0
	—Bridgetown	13	5	30	59	43	15
	—South Point	13	2	0	59	36	0
	Granadillos,						
	—Becouia Island..	13	1	0	61	16	0
	—Curiacou Island.	12	30	0	61	31	0
	Grenada,						
	—North Point....	12	14	0	61	42	0
	—Fort St. George.	12	2	54	61	49	40
	—Point Salines ...	11	58	0	61	52	0
	Tobago,						
	—Man of War Bay	11	22	0	60	32	0
	—South West end.	11	8	0N	60	53	0W
	Trinidad,						
	—The Grand Boca	10	42	0	61	52	0
	—Chagaramus Bay	10	41	0	61	43	0
	—Spanish Town ..	10	39	15	61	34	15
	—Icaque Point .	10	4	0	61	58	0
	—Point Galiote...	10	9	0	61	0	0
	—Point Galera ...	10	50	30	60	56	0

XXVI. The EAST COAST of AMERICA, from Cape Sable to Davis's Straits.

	Places.	Latitude.			Longitude		
		°	′	″	°	′	″
	Cape Sable.......	25	2	0N	81	15	0W
	Var. 6° 15′ E.						
	Dry Tortugas.....	24	31	0	83	10	0
East Florida.	Great Inlet.......	25	0	0	80	27	0
	Cape Florida	25	41	30	80	5	0
	Grenville's Inlet ..	26	47	0	80	1	0
	Hillsborough Inlet	27	14	0	80	12	0
	North end of Matanilla Reef......	27	51	0	79	9	0
	No variation.						
	Cape Canaveral...	28	16	0	80	24	0
	—Outermost Shs. .	28	16	0	80	6	0
	St. Augustine	29	48	0	81	18	0
	St. John's River, ent.	30	18	0	81	30	0
	Amelia Island,						
Georgia.	—N. end, entrance to St. Mary's River	30	40	0	81	35	0
	St. Simon's Sound .	31	2	0	81	28	0
	Darien...........	31	19	0	81	30	0
	St. Catherine's S...	31	40	0	81	0	0
	Sunbury	31	45	0	81	12	0
	Savannah, or						
S. Carolina.	Tybee Light......	32	0	45	80	41	0
	Port Royal.......	32	12	0	80	31	0
	Charleston	32	50	0	79	50	0
	—Light..........	32	43	30	79	46	0
	Cape Roman	33	3	0	79	11	0
	Var. 4° 30′ E.						
	Georgetown Light.	33	14	0	78	56	0
	Brunswick	34	3	0	78	13	0
North Carolina.	Cape Fear Light. .	33	51	15	78	17	0
	Outermost Shoal, .	33	36	0	77	54	0
	Wilmington.......	34	12	0	78	8	0
	New River Inlet .	34	23	0	77	40	0
	Beauford's Entr. . .	34	40	0	76	47	0
	Cape Lookout	34	34	0	76	38	0
	—Shoals, S. E. part	34	22	0	76	33	0
	Beauford.	34	42	0	76	47	0
	Newbern.........	35	5	0	77	15	0
	Occacoke Inlet ...	34	3	0	76	2	0
	Cape Hatteras	35	7	30	75	30	0
	—Shoals, S. E. part	34	54	0	75	22	0
Virginia.	*Var. 1° 45′ W.*						
	Roanoke Inlet	35	51	0	75	56	0
	Cape Henry	36	57	0	75	59	30
	Cape Charles	37	12	0	75	54	0
	Williamsberg	37	13	0	76	46	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
Maryland.	Richmond	38	6	0 N	77	8	0 W
	Annapolis	39	0	0	76	45	0
	Baltimore	39	22	0	76	50	0
	WASHINGTON	38	53	0	77	3	0
	False Cape	38	27	0	75	6	0
	Var. 4° 30′ *W.*						
Delaware.	Cape James, or Henlopen	38	46	0	75	6	30
	Lewis Town	38	47	27	75	9	48
	Newcastle	39	39	0	75	32	0
	PHILADELPHIA	39	56	55	75	10	40
	Cape May	38	57	0	74	56	0
New Jersey.	Great Egg Harb.	39	18	0	74	32	0
	Little Egg Harb.	39	30	0	74	22	0
	New York, or Sandy Hook Light	40	26	40	74	6	15
	Var. 11° 0′ *W.*						
	Perth Amboy	40	30	0	74	33	0
	NEW YORK	40	41	25	74	5	0
Conn.	Montuc Point	41	1	0	71	58	0
	New Haven Entr.	41	17	0	72	59	0
	Connecticut R.	41	16	0	72	25	0
	New London, Light	41	21	0	72	16	0
Rhode Island.	Block Island	41	10	0	71	39	0
	Point Judith	41	24	0	71	30	0
	Providence	41	50	40	71	23	0
	Rhode I., Light	41	27	0	71	24	0
	Newport	41	30	0	71	19	0
	Buzzard's B., entr.	41	28	0	70	57	0
	New Bedford	41	39	0	70	55	0
	Falmouth	41	33	0	70	35	0
	Nomans Land	41	15	0	70	46	0
	Martha's Vineyard,						
	—East Point	41	21	0	70	24	0
	—Squibnocket Hd.	41	17	0	70	44	0
	—Gay Head	41	21	0	70	4[illegible]	0
	Nantuket Shoal,						
	—South Breakers	40	53	0	69	36	0
	Nantuket I., Light	41	23	0	70	1	0
	—Tom Nevers Hd.	41	14	0	69	57	0
	St. George's Bank,						
	—Middle	41	45	0	68	34	0
	Sandy Point	41	34	0	9	55	0
	Cape Cod, Light	42	3	0	70	6	0
	Plymouth	41	59	0	70	45	0
Massachusets.	BOSTON, Town	42	24	30	71	3	0
	—Light	42	21	0	70	53	0
	New Cambridge	42	23	28	71	4	0
	Salem	42	34	0	70	53	0
	Baker's I., Light	42	32	0	70	50	0
	Cape Ann,						
	—Thatcher's Lt.	42	40	0	70	38	0
	Ipswich	42	43	0	70	55	0
N. Hamp.	Newbury Port Lt.	42	48	0	70	51	0
	Isle of Shoals	42	57	0	70	38	0
	Portsmouth, Town	43	5	0	70	46	0
	—Light	43	4	0	70	44	0
	Boon Island	43	7	0	70	27	0
	York River	43	7	0	70	37	0
	C. Neddock Nubble	43	11	0	70	35	0
	Cape Porpoise	43	21	0	70	25	0

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Biddeford	43	23	0 N	70	30	0 W
	Cashes Bank, mid.	43	4	0	69	15	0
	Var. 3° 30′ *W.*						
	Casco Bay,						
	—Cape Elizabeth	43	33	0	70	12	0
	—Yarmouth	43	46	0	70	12	0
	—Portland Light	43	39	0	70	15	0
	—Casco	43	43	0	70	13	0
	Brunswick	43	52	0	70	0	0
	Kennebeck R. entr.	43	43	0	69	47	0
	Seguin Island	43	41	0	69	46	0
	Bantum Ledge	43	42	0	69	38	0
	Townsend B. entr.	43	49	0	69	39	0
	Pennaquid Point	43	48	0	69	30	0
	Manheigen Island	43	44	0	69	16	0
	Ball Rock	43	48	0	68	50	0
	Metinicus Island	43	53	0	68	51	0
	Penobscot	44	24	0	68	45	0
	Haute Island	44	0	0	68	30	0
	Long Island	44	6	0	68	17	0
	Mt. Desert Rock	43	52	0	68	10	0
Coast of Main.	*Var.* 11° 45′ *W.*						
	Gouldsborough Hr.	44	25	0	68	1	0
	Pleasant Bay	44	27	0	67	48	0
	Machios Bay,						
	—Cross Island	44	40	0	67	24	0
	Western Seal Is.	44	37	0	66	54	0
	Manan I., S. Pt.	44	43	0	67	0	0
	Wolf Islands	45	3	0	66	50	0
	Campo Bello Id.,						
	—North end	45	2	30	67	1	0
	St. Croix R., entr.	45	7	0	67	8	0
	Macgone Island	45	18	0	66	4	0
	Cape Spencer	45	16	0	65	52	0
	Cape Chignecto	45	24	0	64	49	0
	Haute Island	45	19	0	64	52	0
	Annapolis Royal	44	45	30	65	46	30
	Briers Island	44	19	0	66	25	0
	Cape St. Mary	44	12	0	66	13	0
	Cape Fourchu	43	51	30	66	10	30
	Gannet Rock	43	40	40	66	9	45
	Seal Is., S. Point	43	25	25	66	0	35
	CAPE SABLE	43	23	45	65	39	15
	Var. 11° 15′ *W.*						
	Cape Negro Island	43	33	5	65	17	30
	Port Roseway, Lt.	43	39	0	65	13	0
	Port Mansfield	43	50	0	64	52	0
	Gambier Harbour	44	0	0	64	41	0
Nova Scotia.	Liverpool	44	5	0	64	40	0
	Port Jackson	44	10	0	64	28	0
	Sambro Hd., Light	44	30	0	63	33	0
	HALIFAX Harb.	44	44	0	63	36	0
	Var. 13° 36′ *W.*						
	Port Stephens	45	0	0	61	58	0
	Sandwich Harbour	45	8	0	61	36	0
	Torbay	45	12	0	61	16	0
	Port Howe	45	14	0	61	3	0
	CAPE CANSO	45	20	7	60	55	0
	Var. 15° *W.*						
	Sable I., E. Point	44	4	0	60	0	0
	—West Point	44	4	0	60	30	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Cape Hinchinbroke	45	34	0 N	60	36	0 W
	St. Esprit	45	37	0	60	27	0
Cape Breton Isle.	Cape Portland	45	48	0	60	3	0
	LOUISBOURG	45	53	40	59	55	0
	Scatery Island	46	1	30	59	38	0
	Flint Island	46	9	0	59	43	0
	Spanish Bay	46	13	0	60	8	0
	Port Dauphin	46	21	0	60	30	0
	Cape North	47	6	0	60	28	0
	Cheticun Harbour	46	42	0	60	58	0
	Sea Wolf	46	27	0	61	12	0
	Port Hood	46	2	0	61	33	0
	Cape North	47	7	0	63	44	0
Pr. Edward's Isle.	West Point	46	37	0	64	10	0
	Var. 16° *W.*						
	Cape Egmont	46	28	0	63	50	0
	Hillsborough Bay	46	6	0	62	56	0
	Charlotte Town	46	14	0	62	50	0
	Port Joy	46	11	0	62	57	15
	Bear Cape	46	3	0	62	13	0
	George Town	46	14	0	62	20	0
	East Point	46	27	0	61	46	0
	Richmond Bay	46	38	0	63	27	0
	Gut of Canso,						
	—North entrance	45	44	0	61	31	0
	Cape St. George	45	52	0	62	0	0
	Pictou Island	45	51	0	62	30	0
	C. Tormentine	46	9	0	63	36	0
	Richibucto Harb.	46	44	0	64	36	0
	Escuminac Point	47	3	0	64	33	0
	Miscou I., entr. to Chaleur Bay	48	4	0	64	14	0
New Brunswick.	Cape Despair	48	27	0	63	57	0
	Bonaventure I.	48	33	20	63	48	0
	Flat Point	48	38	0	63	48	0
	Cape Gaspé	48	47	30	63	50	0
	Magdalen River	49	13	0	64	43	0
	St. Ann's River	49	8	0	66	8	0
	Cape Chat	49	9	0	66	20	0
	Mount Camille	48	37	0	67	20	0
	Bic Island	48	30	0	68	26	0
	Anticosta I., E. Pt.	49	9	0	61	52	0
	—South Point	49	6	0	62	19	0
	—South West Pt.	49	22	0	63	30	30
	—Jupiter's River	49	26	0	63	31	15
Gulf of St. Lawrence.	—West Point	49	50	0	64	20	0
	—North Point	49	52	0	64	0	0
	Magdalen Islands,						
	—North East Pt.	47	41	0	61	5	0
	Var. 17° 45′ *W.*						
	—Amherst Island, South West Pt.	47	15	0	61	48	0
	—Entry I.	47	17	0	61	25	0
	—Deadmans I.	47	17	0	61	58	0
	Biron Island	47	52	0	61	12	0
	Bird's Islands	47	55	0	60	46	0
	St. Paul's Island	47	11	30	60	2	0
	Cape Ray	47	37	0	59	13	0

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Var. 20° *W.*						
	Cape Anguille	47	55	0 N	59	22	20 W
	Cape St. George	48	28	0	59	15	0
	South Head	49	6	0	58	28	0
	Var 22° 30′ *W.*						
	Cape St. Gregory	49	20	0	58	20	0
	Bon Bay	49	36	0	58	5	0
	Ingornchoix	50	37	17	57	15	30
	Point Riche	50	40	10	57	23	0
	St. John's Bay	50	50	0	57	18	0
	Point Ferrolle	51	2	0	57	11	0
	Var. 24° 35′ *W.*						
	Seal Islands	51	20	0	56	50	0
	Cape Norman	51	38	23	56	0	0
	Belle Isle	51	57	0	55	30	0
	Cape Degrat	51	40	0	55	30	0
	St. Lunaire Bay	51	28	57	55	30	0
	Cape St. Anthony	51	20	0	55	36	0
	Hare Bay, entr.	51	17	0	55	45	0
	Croque Harbour	51	3	17	55	50	0
	Groais I., N. end	51	0	0	55	42	0
	Green Island	50	47	0	55	35	0
	Horse Islands	50	21	0	56	51	0
	Cape Partridge	50	16	0	56	12	0
	Cape St. John	50	10	0	55	38	0
	Newbay Head	49	57	0	55	26	0
	Twilingate Islands	50	3	0	54	40	0
	Fago Island	50	0	0	53	54	0
Newfoundland.	Woodham Is.	49	55	0	53	30	0
	Cape Freels	49	34	0	53	0	0
	Cape Bonavista	48	56	0	52	34	0
	Point Grates	48	22	0	52	32	0
	Cape St. Francis	47	57	0	52	30	0
	St. John's Harbour	47	32	44	52	25	30
	Bull Bay	47	21	0	52	29	0
	Cape Broyle	47	8	0	52	35	0
	Ranin Rocks	46	57	0	52	42	0
	Cape Ballard	46	49	0	52	50	0
	CAPE RACE	46	40	0	53	3	30
	Var. 23° 45′ *W.*						
	Cape Race Rocks	46	30	0	51	30	0
	Trepasse Bay	46	43	30	53	16	0
	Cape Pine	46	44	0	53	30	0
	Cape St. Mary	46	52	0	54	7	0
	Var. 22° 46′ *W.*						
	Point Bream	46	59	0	54	12	0
	Virgin Rocks	47	9	0	54	5	0
	Red I., S. Point	47	24	0	54	8	0
	Mortier Harbour	47	10	0	55	3	0
	Mortier Rocks	47	0	0	54	58	0
	Chapeau Rouge	46	53	0	55	22	0
	Point May	46	55	0	56	2	0
	St. Peter's I., Town	46	46	30	56	10	0
	Langley Island	46	52	0	56	21	0
	Great Miquelon	47	10	0	56	23	0
	Burnt Island	47	16	0	56	0	0
	Fortune Head	47	9	0	55	52	0
	Penguin Islands	47	24	0	57	3	0
	Ramea Islands	47	32	0	57	24	0
	Burgeos Islands	47	36	30	57	36	15
	Connor Bay	47	38	0	57	59	0

TABLE XLII.

LATITUDES AND LONGITUDES.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	——						
	QUEBEC	46	48	30 N	71	5	29 W
	Coudres Island,						
Canada.	—North West Pt.	47	15	33	70	18	57
	St. Paul's Bay	47	16	0	70	24	0
	Bay of Rocks	48	0	0	69	42	0
	Green I. Light	48	5	0	69	18	0
	Point Mille Vache	48	45	0	68	38	0
	Manicougan Pt.	49	12	0	67	42	0
	Cape Montpelles	49	27	0	66	51	0
	Seven Islands Bay	50	10	0	66	0	0
	Mingan Isle	50	16	0	63	46	0
	St. John's River	50	20	0	63	57	0
Esquimaux.	Esquimaux Is.	50	18	0	63	15	0
	St. Charles I.	50	19	0	62	56	0
	Hunting I.	50	21	0	62	46	0
	St. Genevieve I.	50	22	0	62	42	0
	Mount Joli	50	5	0	61	27	0
	Little Mecatina	50	28	0	59	30	0
	Great Mecatina	50	45	0	59	6	0
	Var. 23° 10′ *W.*						
	St. Augustin's Bay	51	13	0	58	47	0
	Esquimaux Bay	51	25	0	57	30	0
	Belle Isle	51	57	0	55	30	0
	Cape Charles	52	15	0	55	30	0
Labrador.	C. St. Michael	52	45	0	55	40	0
	Wolf Island	53	42	0	55	36	0
	Sandwich Bay, ent.	53	48	0	56	42	0
	Byron's Bay,						
	—C. Webuck	54	55	0	57	40	0
	Davis's Inlet, ent.	55	48	0	60	12	0
	Port Manvers	56	58	0	62	0	0
	Var. 40° 10′ *W.* 1808						
	Cape Chidley	60	14	0	65	20	0
	Button's Islands	60	35	0	65	20	0
Hudson's Straits.	Cape Resolution	61	29	0	65	10	0
	Saddleback Island	62	7	0	68	13	0
	Upper Savage Is.	62	32	30	70	48	0
	North Bluff	62	34	0	70	56	0
	Cape Charles	62	46	30	74	15	0
	Cape Dorset	64	50	0	77	12	0
	Cape Pembroke	62	57	0	82	36	0
	Cape Walsingham	62	39	0	77	48	0
	Var. 44° *W.*						
	Cape Digges	62	41	0	78	50	0
	Salisbury Islands	63	29	0	76	47	0
	Mansfield L., N. Pt.	62	38	30	80	33	0
	—South Point	61	35	0	81	0	0
	Cape Southampton	62	10	0	86	3	0
	North Sleepers	61	38	0	79	45	0
	West Sleepers	60	8	0	81	36	0
	Portland Point	59	0	0	78	30	0
Hudson's Bay.	Baker's Dozen	58	5	0	79	30	0
	Belchers, N. Pt.	56	20	0	80	15	0
	James Bay,						
	—Cape Henrietta	55	10	0	82	30	0
	—Cape Jones	54	50	0	78	54	0
	—Bear Isle	54	34	0	81	24	0
	—North Cubb	54	20	0	80	48	0
	—The Twins	53	12	0	80	35	0
	—Albany Fort	52	14	40	81	59	58
	—Moose Fort	51	15	54	80	56	6
	—E. Main House	52	15	0 N	78	44	30 W
	—Charlton Island	52	3	0	79	55	0
	York Fort	57	1	48	92	32	0
	Cape Churchill	58	48	0	93	12	0
Davis's Str.	Prince of Wales's Fort	58	47	32	94	13	55
	Marble Island	62	33	0	91	6	0
	Cape Dobbes	65	0	0	86	42	0
	Cape Walsingham	66	0	0	60	50	0
	Cape Aston	70	10	0	65	25	0
	Lancaster Sd. entr.						
Baffin's Bay.	—C. Byam Martin	73	33	0	77	10	0
	—C. Charlotte	74	32	0	79	30	0
	Cape Clarence	76	45	0	77	47	0
	Wostenholme I.	76	24	0	70	22	0
	C. Dudley Digges	76	5	0	68	54	0
	Waygat I.	70	26	17	54	51	49

XXVII. The Coasts of GREENLAND, ICELAND, and SPITZBERGEN, and adjacent Islands.

	Places.	Latitude.			Longitude.		
		°	′	″	°	′	″
	Disco. I., N. Point	70	12	0 N	55	0	0 W
	—South West Point	69	8	0	54	30	0
	Var. 6½ *Pts. W.* 1812						
Greenland.	Muskitto Cove	64	55	13	52	56	45
	Gothaah, entr. of River Bal	64	9	55	51	49	45
	Bear Sound	62	47	0	50	45	0
	Cape Farewell	59	45	0	47	50	0
	Bontokoe Island	73	15	0	7	5	0
	Gael Hawkes Bay	75	0	0	6	51	0
	John Mayen's I.	71	8	20	7	25	48
	——						
	Cape Reikianess	63	55	0	22	47	0
	Bessested	64	6	9	21	53	45
	Mount Snæsell	64	52	20	23	54	0
	Patrixfiord	65	35	45	24	10	0
Iceland.	Straumness	65	39	40	24	29	15
	North Cape	66	34	0	22	10	0
	Hola	65	44	0	19	44	0
	Grim's Isle	66	57	0	19	12	0
	Rikefiord	66	30	0	17	35	0
	Longnose	66	25	0	16	19	0
	Wreeland Isle	63	55	0	18	19	0
	Portland Island	63	22	0	18	50	0
	Cape Heckla	63	22	0	19	54	0
	Westman's Is.	63	20	30	20	27	45
	——						
	South Cape	76	32	0	13	45	0 E
	Fair Foreland	78	53	0	8	45	0
Spitzbergen.	Amsterdam Island,						
	—Hackluyts Hd	79	46	0	9	49	0
	Smeerenburg Hr.	79	44	0	9	50	45
	Var. 18° 57′ *W.*						
	Verleegen Hook	80	7	0	16	50	0
	Hope Island	76	30	0	20	28	0
	Bear, or Cherry Island	74	30	0	19	5	0

THE TIMES OF HIGH WATER,

On the Full and Change of the Moon, at the principal PORTS, and along the COASTS, particularly of GREAT BRITAIN and IRELAND, with the vertical Rise of the Tide in Feet at the Spring Tides.

Places.	Situation.	Times.		Rise
		h.	m.	Feet
A.				
Abbeville	France	10	30	
Aberdeen	Scotland	12	45	
Aberdovy	Wales	7	30	13
Aberistwith	Wales	7	30	13
Achill Head	Ireland	6	0	
Agnes (St.)	Scilly Is.	4	40	18
Air Point	Isle of Man	10	30	
Aix	France	3	0	
Alban's Head (St.)	England	7	30	
Aldborough	England	10	45	10
Alderney Island	Eng. Channel	6	0	32
Alne River	England	2	45	
Alban's (St.)	Jersey	12	30	
Altona	Germany	6	0	
Amazon R.	America	6	0	
Ambleteuse	France	11	0	19
Ameland Island	North Sea	10	30	
Amelia Harbour	America	9	0	
Amlwick Port	Anglesea	10	30	24
Amsterdam	Holland	3	0	17
Amsterdam Island	Pacific Ocean	8	30	
Andrew's Bay (St.)	Scotland	2	15	
Angers	France	12	0	
Angra Bay	Terceira	11	45	8
Anholt Island	Cattegat	12	0	
Ann (Cape)	America	11	30	12
Annapolis	America	10	0	
Anticosta I. W. end	America	3	30	
Antwerp	Batavia	4	25	14
Annamocka	Pacific Ocean	6	0	
Anvers	France	6	45	
Archangel	Russia	6	0	
Archangel R., entr.	Russia	6	30	
Arklow	Ireland	8	15	
Arran Island	Scotland	11	15	9
Arundel	England	9	20	16
Augustine (St.)	America	7	30	6
Augustine's B. (St.)	Madagascar	2	15	
Avranches	France	6	0	
Auray	France	5	45	
B.				
Babelmandel Str.	Red Sea	12	0	
Balasore	India	9	45	12
Ballingskellings B.	Ireland	3	15	
Bally Castle	Ireland	5	45	
Bally Shannan	Ireland	6	45	
Balta	Shetland	3	0	6
Baltimore	Ireland	3	45	12
Bamff	Scotland	11	30	
Bancoot River	India	11	0	11
Bantry Bay	Ireland	3	45	11
Bardsey Island	Wales	8	15	
Barfleur (Cape)	France	7	30	
Barmouth	Wales	8	0	13
Barnstable Bar	England	5	30	26
Bas (Isle de)	Eng. Channel	3	45	27
Basseen River	India	12	30	17
Bate Harbour	Gulf of Cutch	12	0	14
Baudsey Cliff	England	10	30	
Bayonna	Spain	4	45	
Bayonne	France	3	30	
Beachy, on Shore	England	9	45	20
Beachy, Offing	England	11	0	
Bear Island	Hudson's Bay	12	0	
Beaumaris	Wales	10	15	24
Bee's Head (St.)	England	11	10	
Belfast	Ireland	10	30	
Belle Isle	Bay of Biscay	3	0	
Bembridge Point	Isle of Wight	11	40	
Bergen	Norway	1	30	
Bermudas Island	Atlant. Ocean	7	0	5
Berwick	England	2	15	16
Biscay	Spain	4	30	
Bilboa	Spain	3	15	15
Blakeney	England	6	0	16
Blanco (Cape)	Africa	9	45	
Blaskets	Ireland	3	40	
Block Island	America	7	37	5
Blythe	England	2	45	12
Bojador (Cape)	Africa	12	0	
Bolt Head	England	5	55	20
Bombay	India	11	15	15
Bombay Offing	India	12	0	
Borkum Island	Holland	11	30	
Boston	England	7	15	
Boston	America	11	30	12
Botany Bay	New Holland	8	0	
Boulogne	France	10	30	19
Bourdeaux	France	3	0	
Brassa Sound	Shetland	10	0	8
Bray Head	Ireland	3	30	
Bree Bank	North Sea	3	30	
Brehat Island	France	7	30	36
Bremen	Germany	6	0	
Brest	France	4	30	18
Brewershaven	Holland	3	30	
Bride's Bay (St.)	Wales	6	0	
Bridgewater	England	6	45	22
Bridlington	England	4	30	13
Bridport	England	6	45	
Brill	Holland	3	0	14
Brighton	England	10	6	16
Bristol	England	6	45	42
Broad Haven	Ireland	6	0	
Buchanness	Scotland	12	0	
Burnt Island	Scotland	2	30	14

TIMES OF HIGH WATER.

Places.	Situation.	Times.		Rise
		h.	m.	Feet
Busheer	G. of Persia.	7	30	6
Bustard Bay	New Holland	8	0	8
Button's Islands	Hudson's Bay	6	50	
C.				
Cadiz	Spain	4	0	
Caen	France	10	0	19
Caernarvon, Bar	Wales	9	0	22
Cairston	Orkneys	9	0	12
Calais	France	11	30	18
Calcutta	India	3	5	
Caldy Island	Wales	6	0	34
Calf of Man	St. Geo. Chan.	10	30	
Camperdown	Holland	4	30	
Campbell (Port)	America	9	0	
Canna Sound	Ireland	5	15	
Canary Island	Atlant. Ocean	3	0	
Cancale	France	7	30	
Cantin (Cape)	Africa	10	0	
Canso (Cape)	America	8	30	
Cantire (Mull of)	Scotland	9	0	5
Cappel (West)	Holland	0	30	
Capricorn (Cape)	New Holland	8	0	7
Cardiff	Wales	6	0	
Cardigan Bar	Wales	7	0	20
Carlingford	Ireland	9	0	14
Carlisle	England	12	0	
Carlos (Port St.)	S. America	11	30	18
Carmarthen	Wales	6	0	24
Carr Rocks	Scotland	1	30	
Carrick I.	G. of Persia.	9	0	
Carrickfergus	Ireland	10	30	8
Casco Bay	N. America	10	45	9
Caskets	Eng. Channel	8	0	28
Catherine's Pt. (St.)	Isle of Wight	8	30	
Catness	White Sea	5	15	
Cayenne	S. America	3	40	6
Charente R., entr.	France	4	0	20
Charles (Cape)	America	7	0	5
Charles Island	Hudson's Str.	10	0	
Charleston Bar	America	7	0	6
Chatham	England	1	0	
Chepstow	England	7	30	70
Cherbourg	France	7	30	20
Chester Bar	England	10	30	26
Chichester Harb.	England	11	30	18
Chittagong Bar	India	1	0	
Christmas Sound	S. America	2	30	
Churchill (Cape)	Hudson's Bay	7	20	
Clear (Cape)	Ireland	4	30	11
Cockspar	America	9	0	
Cod (Cape)	America	11	30	6½
Condore (Pulo)	China Sea	4	15	7
Conway	Wales	10	15	24
Copeland Island	Ireland	10	30	
Coringa Bay	India	9	45	5½
Coquet Island	England	2	45	15
Cornwall (Cape)	England	4	25	22
Cornwallis (Port)	Pr. of Wales I.	1	30	10
Cornwallis (Port)	Andaman I.	10	0	
Cork Harb., entr.	Ireland	4	30	18
Corunna	Spain	3	0	
Coutance	France	6	0	
Cowes	Isle of Wight	11	15	15
Cracatoa Island	Str. of Sunda	7	0	3
Cromartie	Scotland	11	45	14
Cromer	England	6	45	16
Crookhaven	Ireland	3	0	
Cross Island	White Sea	4	15	
Cuckolds' Point	Thames	2	15	18
Culpee	India	1	45	
Cutch (Gulf of)	India	12	0	
Cuxhaven	Germany	1	0	
D.				
Dartmouth	England	6	10	20
David's Head (St.)	Wales	6	0	
Deadman's Point	England	5	30	
Deal	England	11	15	19
Dee (River)	Scotland	12	45	26
Delagoa Bay	Africa	5	15	14
Delaware Riv., en.	America	9	0	
Demaun, Bar	India	1	30	17
—Offing		2	45	
Denbigh	Wales	2	15	
Diamond Point	India	2	15	
Dieppe	France	10	30	18
Digges (Cape)	Hudson's Bay	12	0	
Dingle Bay	Ireland	3	30	1.1½
Donegal	Ireland	6	30	
Dort	Holland	3	0	
Dover Pier	England	11	16	20
Douglas	Isle of Man	10	30	21
Downs	England	11	15	15
Drogheda	Ireland	10	45	
Drontheim	Norway	2	15	
Dublin	Ireland	9	30	12
Dudgeon Lights	North Sea	6	0	
Dunbagon Head	Ireland	6	0	
Dunbar	Scotland	2	15	
Duncansby Head	Scotland	8	30	
Dundalk Bay	Ireland	10	45	
Dundedy Head	Ireland	4	0	11
Dudgeon Light	North Sea	7	30	
Dundee	Scotland	2	15	
Dungarvon	Ireland	4	30	
Dungeness	England	10	30	24
Dunkirk	France	11	45	19
Dunnose	Isle of Wight	8	56	
Dursey Island	Ireland	3	30	
E.				
Eastern Brace	Bay of Bengal	9	45	
Eddystone	Eng. Channel	5	15	18
Edinburgh	Scotland	2	30	

TABLE XLIII.

TIMES OF HIGH WATER.

Places.	Situation.	Times.		Rise
		h.	m.	Feet
Elbe R., red Buoy	North Sea...	12	0	
Elizabeth Town Pt.	America	8	54	5
Embden	Germany ...	12	0	
Enkhuysen	Holland	12	0	
Etaples..........	France	10	15	19
Exmouth Bar	England	6	25	14
Exuma Bar	Bahamas....	6	35	
Eyder River	Germany....	12	0	
Eyemouth Harb. .	Scotland	2	15	
F.				
Fair Head	Ireland	9	0	
Fair Isle.........	North Sea...	4	0	
Falmouth	England	5	30	18
Fayal Road......	Azores......	2	20	4½
Fear (Cape)	America	9	45	
Fecamp	France	10	0	19
Fernando Noronha	S. Atlantic ..	4	0	6
Ferrol...........	Spain.......	3	0	
Ferriters	Ireland	3	30	
Fifeness	Scotland	1	30	
Filey............	England	4	30	
Finisterre (Cape) .	Spain.......	3	0	
Finmark.........	Lapland	2	15	
Fisgard Bay	Wales	6	30	
Flamborough Head	England	4	30	
Flatholme Isle....	Bristol Chan.	6	40	36
Flats (Kentish)...	England	11	0	
Flemish Banks ...	North Sea...	3	0	
Florida Keys	America	8	30	5
Flushing.........	Holland.....	1	0	15
Fly, or Vlie Gatway	Holland.....	6	45	
Fly, or Vlie Road.	Holland.....	7	30	
Folkstone........	England	10	51	20
Foreland (North).	England	11	15	16
Foreland (South) .	England	11	6	15
Formby Point....	England	10	25	26
Fort George	Scotland	12	0	
Fort St. John	Newfoundl. .	9	0	
Foul Isle	Shetlands ...	3	0	
Foulness.........	England	9	0	16
Fowey	England	5	30	16
Frehel (Cape)....	France	6	0	45
Fulta	India	1	15	
Funchal	Madeira	12	4	7
Fundy (Bay of)..	America			60
G.				
Gallicia (Coast of)	Spain.......	3	0	
Galloper.........	Thames River	12	45	
Galway Bay	Ireland	4	30	
Galloway (Mull of)	Scotland	11	15	
Gambia R., entr..	Africa	10	15	
Gaspé Bay	America	1	30	
Gay Head	America	7	37	7
George River	America	10	45	9
Georgetown Bar..	America	6	40	
Gibraltar........	Spain.......	12	0	
Goa.............	India	4	30	
Good Hope (Cape)	Africa	3	0	
Good Hope (Town)	Africa	2	30	5
Gore............	England	11	15	
Goodwyn (Back of)	Downs......	1	30	
Goree Gatway ...	North Sea...	1	30	
Gouldsborough ...	America	11	0	12
Gowan's Head (St.)	Wales	5	30	36
Granville	France......	7	30	
Gravelines	France......	11	45	18
Gravesend	England	1	30	16
Grizness.........	France......	11	0	
Groyne..........	Spain	3	0	
Guernsey	English Chan.	6	0	32
Gunfleet.........	Thames River	12	0	
H.				
Haerlem.........	Holland.....	9	0	
Hague, La (Cape)	France	9	0	
Halifax..........	Nova Scotia .	7	30	8
Hamburgh	Germany....	6	0	
Hartland Point...	England	6	0	
Hartlepool.......	England	3	45	
Harwich	England	11	30	14
Hasborough Gatt .	England	6	30	
Hastings.........	England	10	36	
Hatteras (Cape)..	America	9	0	
Havre de Grace..	France......	10	30	22
Helegoland	North Sea...	11	0	
Helena (St.)	Atlant. Ocean	2	15	
Helens (St.)	England	11	45	16
Helvoetsluys	Holland.....	1	30	
Henlopen (Cape) .	America	9	0	5
Henry (Cape)....	America	7	0	4
Holms	Bristol Chan.	6	40	36
Holyhead Bay ...	Wales	10	0	24
Holy I. Harbour..	England	2	30	15
Honfleur	France......	10	30	
Holland's Hook ..	Holland.....	3	0	
Hooringottah R. en.	India	12	0	
Horn	North Sea...	12	0	
Hosely Bay......	England	11	0	11
Hull	England	6	0	18
Humber R. entr. .	England	5	15	18
Hung Road......	England	6	45	46
Hurst Castle	England	10	0	
I.				
Ice Cove	Hudson's Bay	10	0	
Ingellee	India	11	0	
Ipswich	England ...	12	0	
Ireland, W. Coast	Atlant. Ocean	3	0	
Ireland, S. Coast.	Atlant. Ocean	5	51	
Isle de Bas......	France	3	45	27
Isle de Dieu	France	3	0	
Isle of Man, S. side	St. Geo. Chan.	10	20	

TABLE XLIII.

TIMES OF HIGH WATER.

Places.	Situation.	Times.		Rise
		h.	m.	Feet
Ives (St.)	England	4	30	22
J.				
Jackson (Port) ...	New Holland	8	15	6
Janeiro (Rio)	S. America ..	4	30	
Jask Bay	G. of Persia.	6	0	6
Jersey Island	Eng. Channel	6	0	38
John's (St.)	Newfoundl. .	6	0	
John's (St.) River.	Bay of Fundy			24
Jutland Coast	Denmark ...	12	0	
K.				
Kedgeree	India	11	30	
Kenmare River ..	Ireland	3	30	11
Kennebeck	America	10	45	9
Kentish Knock...	Riv. Thames	11	30	
Killibegs	Ireland	6	45	
King's Channel...	Riv. Thames	12	0	16
King's Island	Bass's Straits	3	30	12
King's Road	Bristol Chan.	6	45	42
Kinsale..........	Ireland	4	30	
Kinnaird's Head..	Scotland	12	0	
Kirkudbright	Scotland	11	15	
Kykduyn	Holland.....	7	30	12
L.				
Lagos Bay.......	Portugal	2	0	13
Lambanes	Shetland	9	30	5
Lancaster	England	11	15	
Land's End	England	4	30	
Leith Pier	Scotland	2	20	15
Leman and Ower.	North Sea...	7	0	
Lerwick.........	Shetland	9	45	10
Lewis Islands	Scotland	6	0	11
Lewis (Butt of) ..	Scotland	6	45	
Limerick	Ireland	6	30	16
Lisbon	Portugal	2	15	
Liverpool	England	11	0	27
Lizard Point.....	England	4	55	18
—Off Shore......		7	55	
Loch Swilly......	Ireland	7	30	
Loire River......	France	3	0	
London	England	2	40	19
Londonderry.....	Ireland	6	0	
Long Island	America	3	0	
Long Sand Head .	Riv. Thames	11	30	15
Longships	England	4	30	20
Lookout (Cape) ..	America	10	30	7
Loop Head	Ireland	4	30	
L'Orient.........	France......	4	30	15
Lowestoff, in Shore	England	9	0	
Lowestoff Roads .	England	9	10	7
Lundy Island	Bristol Chan.	5	15	30
Lyme Regis	England	6	45	13
Lymington.......	England	11	15	
Lynn Deeps	England	6	0	20
M.		h.	m.	Feet
Machias	America	11	0	12
Madeira..........	Atlant.Ocean	12	4	7
Macoa	China	9	50	10
Maes River	Holland	3	0	
Majambo Bay....	Madagascar .	5	0	13
Malacca Roads...	India	10	30	
Maloes (St.)	France	6	0	45
Marble Head	America	11	30	12
Margate Roads...	Riv. Thames	11	45	16
Martin Vas	Atlant.Ocean	3	45	
Mary's (St.)......	Scilly Isles...	4	40	18
Mary, St. (Cape) .	Nova Scotia .	9	0	14
May Island	Scotland	1	30	
May (Cape).......	America	8	40	6
Mergui..........	India	12	0	15
Milford Haven ...	England ...,	6	0	36
Minehead	England ...	6	0	36
Mizenhead.......	Ireland	3	0	
Mogadore	Africa	4	0	12
Mombas.........	Africa	12	0	8
Mongallou River .	Africa	3	45	
Montrose........	Scotland	1	30	
Morlaix	France......	5	15	30
Morocco Coast...	Africa	2	15	
Mount's Bay	England	4	55	19
Mozembique	Africa	4	15	12
N.				
Nantucket.......	America	12	3	6
Nantz...........	France	4	0	
Nantz River, entr.	France	3	0	
Narreenda Bay...	Madagascar .	5	45	
Nassau	N. Provid. ..	7	30	7
Natal River......	Africa	10	0	12
Needles	Isle of Wight	8	56	9
Newcastle	England	4	0	
New Bedford	America	7	37	5
Newbury Port ...	America	11	15	10
Newhaven	England	10	16	20
New London.....	America	8	54	5
Newport	Wales	6	45	24
Newry	Ireland	12	0	
New York.......	America	8	54	5
Nicholas (St.)....	England	6	45	
Nieuport	France	12	15	17
Nootka Sound....	N. America..	12	20	9
Nore Light	Riv. Thames	12	30	14
North Berwick...	Scotland	1	30	
North Cape......	Lapland	3	0	
O.				
Olonne..........	France	3	30	
Oporto..........	Portugal	3	15	
Orfordness.......	England	11	0	11
Orkney Islands...	North Sea...	10	30	8

TABLE XLIII.

TIMES OF HIGH WATER.

Places.	Situation.	Times.		Rise
		h.	m.	Feet
Orm's Head	Wales	10	30	
Ortegal (Cape)	Spain	3	0	
Ostend	France	12	20	16
Owers	English Chan.	11	0	15
P.				
Padstow	England	5	0	24
Palmiras Point	India	8	30	
Passamaquoddy R.	America	11	30	25
Passier Roads	Borneo	5	0	9
Patta	Africa	4	30	9
Penmarks	France	3	30	
Penobscot River	America	10	45	10
Pentland Frith	Scotland	10	30	8
Penzance	England	4	30	19
Peter Head	Scotland	12	0	
Peveral Point	England	9	0	
Philadelphia	America	2	0	
Plymouth Sound	England	5	30	18
Plymouth	America	11	30	6½
Pol de Leon (St.)	France	5	15	
Pomona	Orkneys	3	0	
Poole	England	9	0	7
Port Glasgow	Scotland	11	45	
Port Hood	Cape Breton	7	30	8
Port Howe	Nova Scotia	8	30	8
Port Jackson	Nova Scotia	8	0	7½
Portland Bill	England	7	15	8
Portland Race	England	9	15	7
Portland Road	England	6	15	
Portland	America	10	45	9
Port Louis	France	4	30	15
Port Porto	France	3	0	
Porto Praya	C. Verd Isles	6	0	5
Port Roseway	Nova Scotia	8	15	8
Port Royal	Virginia	8	20	
Port Royal	Jamaica			9 in.
Port Royal, entr.	America	8	0	
Port Rush	Ireland	5	45	6
Port Seaton	Scotland	2	0	
Portsmouth Harb.	England	11	36	18
Portsmouth	America	11	15	10
Portugal (Coast of)	Europe	3	45	
Praule Point	England	5	55	
Preston Pans	Scotland	2	0	
Puerto de Naos	Lanzarote I.	11	45	
Pulo Pinang	India	2	0	10
Purfleet	River Thames	1	40	17
Q.				
Quebec	Canada	8	10	
Queda Road	India	10	0	6
Queenborough	England	1	15	
Quiloa Harbour	Africa	3	45	
R.				
Rachlin Island	Ireland	9	30	
Rajapour	India	11	0	12
Ram Head	England	5	45	
Ramkins	Holland	1	30	
Ramsey	Isle of Man	10	30	
Ramsgate	England	11	20	21
Rhe Island	Bay of Biscay	3	0	
Rhode Island	America	7	37	5
Rio Janeiro	S. America	4	30	
Robin Hood's Bay	England	3	45	
Rochefort	France	3	0	
Rochelle	France	3	45	
Rochester	England	1	0	
Rodrigues Island	Indian Ocean	12	45	6
Roman (Cape)	America	10	30	
Roseness	Orkney	10	30	
Rotterdam	Holland	3	30	7
Rouen	France	1	0	
Roymongril R. ent.	India	11	30	
Rye Harbour	England	10	36	24
S.				
Sable (Cape)	Nova Scotia	8	0	9
Sable Island	America	8	30	7
Salangor Roads	India	5	0	
Salcombe	England	5	55	20
Salem	America	11	30	12
Saltees	Ireland	5	40	12
Salvador (St.)	S. America	3	45	
Sandwich	England	11	0	
Sandwich Bay	Nova Scotia	9	0	8
Sandy Hook	New York	7	30	6
Savannah (entr. to)	America	11	15	
Scarborough	England	4	30	13
Scaw	Denmark	12	0	15
Scilly Islands	Eng. Channel	4	40	18
Scolt Head	England	6	20	
Seaford	England	10	16	20
Seal Islands	Bay of Fundy	8	45	12
Seaton Sluice	England	2	45	10
Seine River	France	9	0	
Selsea Bill	England	9	36	16
Selsea Harbour	England	11	15	15
Senegal R., entr.	Africa	10	30	
Seven Cliffs	England	9	50	
Seven Islands	Lapland	9	0	15
Shannon R., entr.	Ireland	3	45	12
Sheerness	England	12	0	15
Shellocks	Ireland	3	0	
Sheepscut	America	10	45	9
Shetland, S. end	North Sea	10	30	6
Shields	England	3	0	13
Shipwash	River Thames	12	0	
Shoreham	England	9	21	16
Sierra Leon	Guinea	8	15	
Simon's Bay	Africa	3	30	3
Simon's Bar (St.)	America	7	30	6
Skerries	Wales	9	45	
Skerries	Ireland	4	45	11

TIMES OF HIGH WATER.

Places.	Situation.	Times.		Rise
		h.	m.	Feet
Sky Island	Scotland	6	0	
Sligo	Ireland	6	45	
Slyne	Ireland	5	15	
Smalls	Wales	5	50	
Smerwick Bay	Ireland	3	30	
Smith's Knowl	North Sea	12	0	
Solebay	England	10	30	7
Somme River	France	10	30	
Southampton	England	11	45	18
Southwould	England	9	0	
Spain (North Coast of)	Bay of Biscay	3	0	
Spithead	England	9	30	
Spurn Point	England	5	15	20
Stadtland	Norway	12	0	
Staples	Scotland	2	30	15
Start Point	England	5	55	20
Staxigo	Scotland	9	15	
Stockton	England	4	30	
Stonehaven	Scotland	1	0	
Strangford Bay	Ireland	10	30	
Stromness	Orkneys	10	30	
Suez	Red Sea	12	0	6
Sunbury	N. America	9	30	
Sunderland	England	3	0	12
Surat	India	4	20	
Swansea	Wales	6	0	20
Sweetnose	Lapland	8	0	16
Swin	Riv. Thames	12	0	16
T.				
Table Bay	C. Good Hope	2	30	5
Tavay Island	India	9	0	15
Tay Bar	Scotland	2	0	
Tees River	England	3	30	16
Telling (Cape)	Ireland	6	0	
Terceira	Azores	11	45	8
Tervere	Holland	1	30	
Texel (entr. to)	Holland	6	45	
Texel Road	Holland	7	45	6
Thames R. (mouth)	England	12	0	
Tinmouth	England	3	0	13
Tod Head	Scotland	12	30	
Topsham	England	7	5	10
Torbay	England	6	10	20
Tor Harbour	Red Sea	10	30	5
Tory Island	Ireland	6	0	
Townsend	America	10	45	9
Trallee Bay	Ireland	3	45	
Trincomaley	Ceylon Island	6	0	3
Tudwal's Road (St)	Wales	8	0	20
Tuskar Rock	Ireland	6	30	
Typa Roads	River Canton	10	0	6
U.				
Use and Villiane R.	France	3	0	
Ushant, within	France	3	45	20
Ushant, without, in the Offing	France	4	30	
V.				
Valdivia	S. America	11	30	6
Valentia Harbour	Ireland	3	30	
Vallery en Caux (St.)	France	10	15	18
Vannes	France	5	45	
Vincent (Cape St.)	Spain	2	15	
Vlie Passage	Holland	9	0	
W.				
Wardhuys	Lapland	4	0	
Wallet	Riv. Thames	11	15	
Watchet	Bristol Chan.	6	45	
Waterford Harb.	Ireland	5	30	13
Weems	Scotland	2	0	
Weser R., entr.	Germany	12	0	
Weilings	France	1	30	
Wells	Norfolk	6	0	
Western Brace	Bay of Bengal	9	36	
Wexford Harbour	Ireland	7	30	
Weymouth	England	6	30	7
Whitby	England	3	45	13
Whitehaven	England	11	15	
Wick	Scotland	9	15	
Wicklow	Ireland	9	0	
Wilmington	America	11	0	
Winchelsea	England	12	45	
Winterton	England	8	15	10
Wisbeach	England	7	30	
Woodbridge Bar	England	11	30	14
Woolwich	England	2	15	18
Wrath (Cape)	Scotland	8	15	
Y.				
Yarmouth Roads	England	8	45	8
Yarmouth Sands, (the back of)	England	10	30	
Yarmouth	Isle of Wight	9	30	12
York Fort	Hudson's Bay	9	10	
Yorkshire Coast	England	6	0	
Youghall	Ireland	5	0	11
Z.				
Zanzibar	Africa	4	30	12
Zuder Zee	Holland	1	30	
Zuric Zee	Holland	3	0	

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